

Surgery, Gynecology and Obstetrics

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NUMBER 1

KIDNEY PELVES

NORMAL VARIATIONS IN THEIR SHAPE AND FLOW WITH POSSIBLE PATHOLOGICAL SIGNIFICANCE

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EVERY urologist is familiar with the variations in shape, size and location of kidney pelvis. Six years ago it occurred to us that, from the standpoint of hydrodynamics, this variation might be a factor in inviting pathological changes such as pyelonephritis—pyogenic or tuberculous—stone formation, nephralgia and hematuria. It has long been recognized that a completely duplicated kidney pelvis and ureter, though a congenital malformation, may serve an individual perfectly for a lifetime. But it is also well known that in such kidneys drainage is frequently unsatisfactory, predisposing to pathological change. With this in mind we undertook a study of less complete abnormalities that is pelvis which while classified as normal might in the process of emptying permit either constant or temporary stasis of small amounts of urine, in all or in certain portions of the kidney pelvis, and thus predispose the organ to any of the pathological changes in which stasis is a recognized etiological factor. Such a pelvis we have termed "dysuric."

There has been a satisfactory clinical application of these ideas since their inception. Three hundred and eighty-five pyelograms together with the histories of the cases have been analyzed and this has led to the following conclusions:

A "non-dysuric" kidney pelvis is one in which the drainage system of the kidney is symmetrically placed throughout the renal tissue and furnishes free flow of urine through all its parts, from minor to major calyces, to pelvis, to ureter because of the following: The capacity interrelationship of these parts one with another, the sufficiency of the angle of junction of one part with another, and the freedom from peristaltic interference of any unit with that of another. In such kidneys there will be neither permanent stasis nor transient "crowding" of urine in any one or more of the principal drainage units, major calyces, minor calyces, pelvis, or ureter.

It follows that a kidney deficient in any of the requirements for a "non-dysuric" pelvis is either actively or potentially "dysuric." An actively "dysuric" pelvis is one in which

the flow is imperfect in the absence of a secondary stasis factor. A potentially 'dyuric' kidney pelvis is one which may require change in position, an increased fluid intake, alteration in the blood supply, infection, change in intrapelvic pressure, secondary (system) or trauma to institute the dysfunction. It is our belief that pelvis bowing, one or more physiologically obstructive emptying defects can cause the symptoms objectively as in multiple hydronephrosis or subjectively alone as in a pyeloid kidney. Or they can be a factor in the actual change such as infection (simple or infectious) or in calculus formation.

The term stasis is not meant to designate two types, namely complete retention and the other partially incomplete or intermittent retention. The former produces a thinning in the musculature of the obstructed organ while the latter primarily induces compensation by hyperplasia of the muscle. Depending upon the degree and the type of resistance in play this increased force of the muscular contraction traumatizes causing pain or hemorrhage or both and continues and exacerbates an infection. The actual stasis following the stage of muscular decompensation produces a relative anasthesia, the result of the long continued pressure in a thinning musculature. Therefore incomplete stasis, in its inception and early phases, induces an hypertrophy of the musculature and because of its early resistance to retention additional trauma with actually less retained urine results. In the later stages there is greater retention of urine with less muscular resistance but with an infection superimposed.

We believed that a classification which would enable us to analyze the drainage facilities of the individual kidney would aid in discovering stasis of urine in all or in some portion of the kidney pelvis or ureter. If stasis could be discovered a missing etiological factor in certain kidney diseases would be known. Our classification begins with complete duplication of the pelvis and ureter and progresses through types and degrees of 'dyuric' pelvis to those of the "non-dyuric" type.

In a normal individual each kidney is responsible for the formation and output of suggestively at least one-half the total amount of urine. This urine is transmitted to the bladder by a dilatable neuromuscular system which is moveable in all its component parts from fat enclosed intrarenal calyces to pelvis and ureter. Peristaltic contraction forces the fluid from minor to major calyces to pelvis, to ureter. Within the kidney this contraction is made possible by the freedom of motion afforded by the fatty tissue which cushions the calyces and intrarenal pelvis.

In order to have adequate drainage require-
ment each portion of the kidney pelvis, relative to the drainage facilities present, we divided the kidney into units accepting papillae (represented pyelographically by minor calyces) as the primary drainage unit. These units (papillae) average from six to fourteen (occasionally more) in number and furnish an outlet for an average of approximately two hundred papillary ducts of the entire kidney. The superior and inferior pole papillae have one-third to one-half more papillary openings than the lateral as they drain the poles as well as the adjacent lateral pyramids. The pyramids may vary somewhat in length in accordance with the shape of the kidney and placement of the pelvis but not to the same extent as do the calyces. In other words the calyces extend to the emptying tips of the pyramids rather than the pyramids reaching to the calyces. The lobulations on the surface of the kidney do not indicate the number of pyramids as we understand that term because there are also interstitial lobules in the columns of Bertini.

Spatzholz states. The medulla surrounds the renal sinus and is made up of an average of thirty conical masses which he calls pyramids. The apices of these end in papillae and project into the renal sinus at the beginning of the calyx. The apices of the pyramids become fused so that each papilla represents two or three pyramids at the center of the kidney and six or more at the upper and lower poles.

The importance of this functional division of the kidney lies in the fact that one can grossly estimate the amount of urine which



Pyelogram 1.

Pyelogram 2

Pyelogram 3.

Pyelogram 1. Completely bifid pelvis and ureters. A. J., female, aged 24 years. In this case the ureteral orifice from the superior calyx entered the bladder above that from the lower pelvis. No history of infection or nephroptosis although there was a history of pyelitis in childhood. Pain was reproduced by overdistention of the superior pelvis with sterile water through a ureteral catheter. This pole had dilated very little due to its small requirement and capacity. Drainage of the lower portion was unusually direct and blocked that of the upper by ureteral contact. Other pyelograms outline the minor calyces of the upper portion which, apparently are two in number. Resection of the upper pole gave immediate relief. Unfortunately on the fifth day after operation, a severe secondary hemorrhage occurred requiring a pedicle clamp with subsequent removal of the remaining portion of the kidney.

Pyelogram 2. Completely bifid pelvis and ureters. A. K., female, aged 28 years. Nephralgic right kidney. Pain was reproduced by overdistending the superior calyx which is of a secondary pelvic type with small capacity yet has at least three pyramidal openings, thus having a capacity requirement of at least one-third of the total urinary output of one kidney. Furthermore, when the urine is received by this small, deeply placed, intrarenal storage space it causes greater back pressure pain by reason of further interference with the flow from ureteral contact. Such a pelvis suffers greater stress at times of large fluid intake. This type of stasis (upper pole) causes pain but does not tend to maintain a permanent infection on account of the rapid peristalsis. The lower pelvis might show stasis at times, cause no pain on account of greater elasticity but permit of sufficient multiplication of organisms to invite pyelitis, etc. There is no record of surgery in this case.

Pyelogram 3. Nephralgic bifid kidney pelvis and ureter not infected. V. F., female, aged 33 years. Pain was re-

lieved at times by ureteral catheterization, at other times made worse. Patient's typical pain could be reproduced by filling the upper calyx. While distention of the lower calyx caused pain, it did not reproduce the typical pain. Heminephrectomy upper pole, was done with perfect relief. There was no evidence of scar tissue or aberrant blood vessel at operation. We believe the "dysuric" factor to have been a ureteral interference both by direct contact of one ureteral wall with the other and by the peristaltic wave of the larger (lower) portion interfering with the emptying of the upper portion. There was no associated nephroptosis.

Fig 1. Completely bifid pelvis and ureters. Actively "dysuric" If the ureters in their normal position, offer sufficient interference to peristalsis by contact to cause any degree of stasis. This stasis will occur in that portion having the less perfect drainage system. Potentially "dysuric" to a sensitive degree when any of the described secondary "dysuric" factors coexist. In such kidneys the ureters normally cross twice although occasionally single crossing occurs. Over distention of the ureters with pyelographic media and ureteral catheter often, on pyelogram alter the true picture of the ureters.

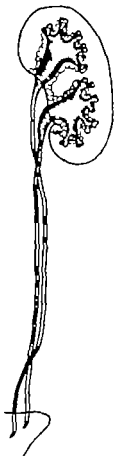


Fig 1

each major calyx receives from the number of minors emptying into it and, with this as a basis estimate the required storage capacity of these receiving calyces and of the pelvis.

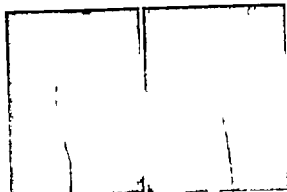
We find that no special type of kidney can arbitrarily be termed "dysuric"

from its gross appearance. The drainage system of each individual kidney must be analyzed according to pelvic and calycine capacity, contour, angles of junction of one part with another, and all these must be taken into consideration and one's opinion based upon the possibilities of stasis in any of the drainage



Pyelogram 4

Pyelogram 5



Pyelogram 6

Pyelogram 7

Pyelogram 6. M. H. M., female, aged 23 years. Nephralgia. Incompletely blind pelvis and ureter with the superior calyx of the secondary pelvis type. This, by its large output, small capacity and angle of junction of its ureter with that of the lower pelvis, has gradually caused the menace of the lower pelvis to decompensate. The inferior ureterocalyxine line is suggestively sharp indicating that the pelvis is deeply placed within the renal sinus. This, in turn, suggests that the lower portion had a small true pelvis and large calyxine capacity which would assist the upper portion in its victory over the lower. A heminephrectomy of the lower portion was performed.

Pyelogram 7. M. D. female, aged 53 years. Left nephrothiasis, cystitis since childhood at present complicated by stone. Analysis shows a sharp inferior ureterocalyxine line with the ureteral line definitely visible. The kidney is somewhat dilated by a long standing, low grade pyelonephritis. The opposite kidney pelvis and ureter are normal and present no symptoms. It is suggested that in this case the congenital malformation evidently played a part in the early and continued pyelonephritis which, in association with stasis, contributed to the stone formation.

Pyelogram 8. E. M. female, aged 5 years. Backache, cystitis (Bacillus coli) appendectomy previously performed. Pyelogram shows unilateral incompletely blind pelvis and ureters. No infection present. While the left kidney was clear at the time of its catheterization, we feel that it was probably the source of the cystitis and that,

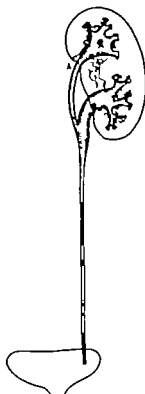


Fig. 2.

even though on the left side it might have caused the backache and bladder symptoms. The pyelogram demonstrates the point that the right and left pelvis in the same individual can be markedly dissimilar.

Pyelogram 6. R. C., female, aged 23 years. Nephralgia. Incompletely blind pelvis and ureter with the superior calyx of the secondary pelvis type. This, by its large output, small capacity and angle of junction of its ureter with that of the lower pelvis, has gradually caused the menace of the lower pelvis to decompensate. The inferior ureterocalyxine line is suggestively sharp indicating that the pelvis is deeply placed within the renal sinus. This, in turn, suggests that the lower portion had a small true pelvis and large calyxine capacity which would assist the upper portion in its victory over the lower. A heminephrectomy of the lower portion was performed.

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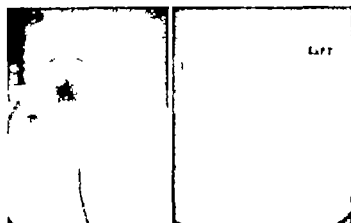
Fig. 2. Incompletely blind pelvis and ureters. May be actively dysuric by virtue of the angle of junction of the ureters, or disproportion between the drainage capacity and requirement of the two portions. Either major division may gain the right of way thus damming up the remaining portion. May be potentially "dysuric" particularly in the upper major calyx should a change in the position of the kidney cause a slight degree of angulation and obstruction at its junction with the inferior major calyx.

Pyelogram 8. F. L. M., male. Acute pyelonephritis following sphenoidectomy. By an estimate of the minor calyces we feel that the lower portion has a capacity requirement of the inflow of one minor calyx more than the upper portion which is of a definite secondary pelvic type. The upper infundibulum is anatomically and functionally a continuation of the ureter (there is no common pelvis) into which the lower infundibulum enters at an unsatisfactory angle (almost 90 degrees). The flow from the upper blocks the outflow from the lower by its rapid peristaltic flow. Close observation suggests that the lower calyces are thickened and blunted by a spreading of the minor calyces rather than by a pushing up of the papilla. From this analysis we feel that the lower portion is infected. The part which shows stasis in any bifid type of pelvis is determined by minor accessory "dysuric" factors.

Pyelogram 9. J. Y. female. Perinephric abscess, bifid pelvis. While there is no common pelvis present and a large calyces capacity the distribution of the drainage system to renal tissue is good and the angle of entrance of the two infundibula excellent. The chief "dysuric" point in this bifid pelvis is the large calyces capacity. The kidneys were not infected at the time of ureteral catheterization. Could this relative minor calyces stasis of urine sometimes be a factor in perinephric abscess?

Pyelogram 10. M. M. D. female. Tuberculous kidney, no operation. The chief "dysuric" points are the absence of a common pelvis, large calyces capacity and the junction of the two divisions. That is, the lower has larger calyces capacity requirement. Early stasis would be likely to occur in the lower portion, chiefly the deeply placed minor calyces, when the upper pole was in the process of emptying. Nearly two-thirds of the kidney's output must use the lower infundibulum. One cannot satisfactorily visualize the junction of the infundibula.

Pyelogram 11. G. L. Pyelitis of pregnancy, gravis III, pyelitis associated with first and last pregnancies. Left kidney not infected although definitely "dysuric" in outflow. Right kidney shows a typical dilatation of pregnancy. While the left kidney is bizarre, one cannot point to a definite inequality between the upper and lower portions. The fact that the upper portion has the greater capacity

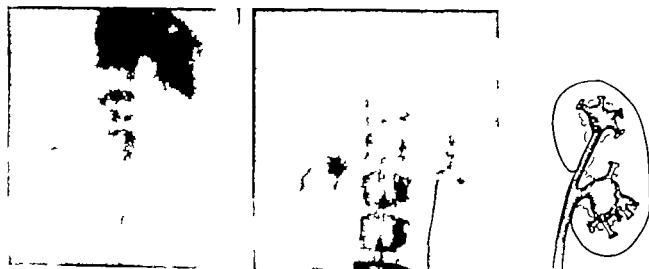


Pyelogram 8.

Pyelogram 9.

requirement and the most direct drainage argues heavily against any pelvic dysfunction. A peristaltic wave beginning above passes directly down the ureter tending to block the lower portion which has, however sufficient capacity for storage while the upper portion empties. The lateral calyces in the upper portion if of sufficient output, could block the upper part of that division. We feel that the left side has to do with the original introduction of the organism. If we could reconstruct the mild right hydronephrosis, possibly but not probably, it might present a "dysuric" factor. In a rapidly emptying pelvis such as the left, organisms are recovered with difficulty at times of large fluid intake. This pyelogram is presented to show our inability to diagnose definitely a "dysuric" pelvis from a single pyelogram and to illustrate the possible sources of error in culture or stain of urine from a rapidly flowing pelvic stream.

Fig 3. Bifid type of intrarenal pelvis with no common or true pelvis. Functionally this type is quite similar to that in Figure 2. Anatomically the only difference lies in that here the infundibula (functioning as bifid ureters) of the superior and inferior major calyces join within the renal sinus rather than along the course of the ureters.



Pyelogram 10.

Pyelogram 11

Fig 3.



Pyelogram 12



Pyelogram 13



Fig. 4

Pyelogram 12. H. B., male. Tuberculosis, left kidney. Large calyces with small common pelvic capacity. The lower portion had a direct outlet in the small common pelvis into which the upper empties through a narrow unfundibulum (in which the tip of the ureteral catheter rests). There is some dependency of the inferior calyx which, at the time of nephrectomy showed early pelvic tuberculosis. In such pelvis we believe that the parenchymatous tuberculous lesion ruptures into

the pelvis which, in turn, is predisposed to secondary involvement depending upon the degree of "dysuria" present. It would be interesting to note that healed renal tuberculosis occurs in non-dysuric pelvis.

Pyelogram 13. G. G. female. Tuberculosis pyonephrosis which shows dilatation of the minor calyces. The kidney pelvis proper has a very small capacity. It is this type of kidney pelvis which can often become infected at several points, that is, a more general intrapelvic spread secondary to a primary parenchymatous lesion. It would be equally susceptible to a regurgitant (bladder) or lymphatic (retro-

teral) spread of the infection. In contrast to this a true bifid kidney and ureter shows a slow spread to the portion of the better drainage. As this pelvis can be reconstructed to its original type, small pelvic and large minor calyces capacity of lesser degree only than presented here, so also can most dilated pelvis be reconstructed, at least mentally to their approximate original size and outline. Often, one is able to determine that marked dysfunction was a primary factor in the kidney damage. In this case due to a lack of common pelvis, each minor calyx served as its own reservoir while the others emptied. The attempt of the kidney to excrete organisms without damage to itself failed due to stasis and pressure trauma within these units, thus allowing the organisms to invade the pelvic mucosa. In this manner a vicious circle of dysuric factors was instituted.

Fig. 4. Small true pelvis with consequent large calyces capacity. This dysuric formation occurs so often in association with other factors such as a bifid type of intrarenal pelvis (Fig. 3) that it is difficult to establish it as a separate "dysuric" entity. Its importance lies in that if a perfect balance does not exist between calyces of rather large though insufficient capacity and one of them, by

virtue of its greater requirement becomes blocked in any degree by other portions having better drainage facilities, one will eventually show some stasis.

units, before a kidney can be designated as non-dysuric or dysuric.

The most important single result of 'dysuria' in any portion of the drainage system of the kidney is stasis. Stasis invites infection by allowing time for organisms to multiply. It produces nerve and vascular symptoms by pressure. Stasis of urine may occur in a portion of the pelvis as a result of the com-

mandeering of its outlet by the superior drainage facilities of another portion or it may occur in the entire pelvis because of insufficient storage capacity. In either instance we have muscular thickening (compensation) and eventually thinning or dilatation (decompensation). A dilating portion of the kidney pelvis first occupies the circumscribing fat area and later encroaches on the



Pyelogram 14.



Pyelogram 15

Pyelograms 14 and 15 L. L. Female. Pyelonephritis, right. Pyelogram 14 was taken with patient in the recumbent position, 15 with patient in the erect position. The dependent, large capacity calyx and the inferior ureterocalyx line are definitely altered on a very slight degree of ptosis. The superior (secondary pelvic type) calyx shows continued direct emptying with the altered position. This type is rare and constitutes a minor degree of dysfunction but, in our experience, can exhibit a degree of lower calyxine stasis. It is usually seen with other dysuric factors notably small pelvis with large calyxine capacity.

Pyelogram 16 M. N. female. Nephralgia and pyelonephritis (*Bacillus coli*) left. Dependent inferior major calyx with a capacity demand of 50 per cent of the kidney's output. This calyx is of a suggestively secondary pelvic type (much more frequently found in the superior calyx) and empties through a common pelvis of small capacity. For these reasons stasis could occur and with a

large fluid intake (not necessarily with the addition of other secondary dysuric factors) could cause over distention with pain and pelvic trauma. Such a dependent calyx associated with small true pelvic capacity would predispose to a chronic pyelonephritis in our opinion.

Fig 5 High placed sinus renalis with consequent dependency of major capacity portion of the renal pelvis. The chief dysuric factor here is the lower major calyxine dependency which being deeply placed within the kidney causes a sharp inferior ureterocalyx line. The upper calyces have better drainage facilities and gain the right of way over the larger dependent calyx in which stasis may occur.



Pyelogram 16

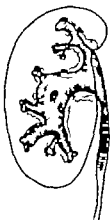


Fig 5

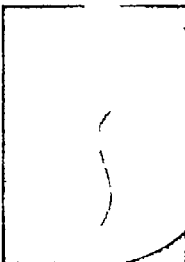
renal tissue by pressure. When this occurs the pelvis loses its sensitivity to back pressure through a physiological pressure anaesthesia. Because of this in retrograde filling greater pressure is required to develop renal pain on the involved side and such pelvis are often seen to be overdistended with pyelographic fluid. As decompensation progresses, vascularity of mucosa and muscularis diminishes.

Necessarily, the more renal tissue that calyces of small capacity must drain the more rapid must be the flow of urine thus requiring more frequent and stronger peristaltic waves. A pelvis which at first glance appears to be bizarre may be normal in its mechanics, whereas one which is apparently

"non-dysuric" may, on analysis, prove to be "dysuric" in a marked degree. For example, even a spider leg pelvis may be "non-dysuric" if all its angles and capacities are distributed to insure even and unobstructed flow of urine. A small pelvis tends to "overcrowd" and produce calyxine back pressure. A large square pelvis, on the other hand, with consequent small calyxine capacity, empties slowly, and this may be a factor in producing stasis. An extrarenal pelvis offers less resistance to back pressure than one which is intrarenal. Therefore if it is not infected, upon dilatation, pain or bleeding is less likely to occur than it would in a deeply placed intrarenal pelvis of similar capacity but with less elasticity.



Pyelogram 7



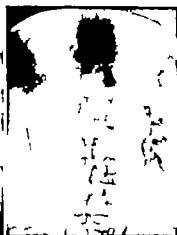
Pyelogram 18



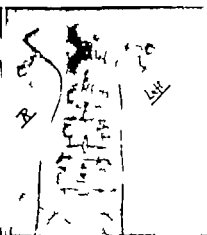
Pyelogram 9



Pyelogram 20



Pyelogram 2



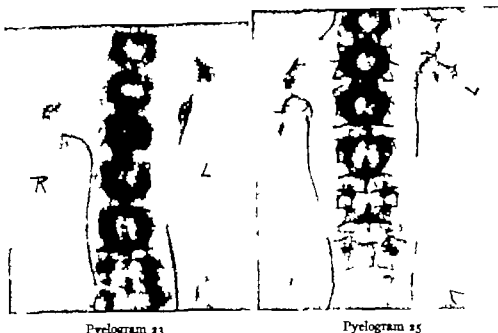
Pyelogram 22

Pyelogram 7. K. S., female, aged 50 years. Pyelonephritis, left nephralgia, left. Shows dilatation of the superior major calyx due to lack of a common pelvis of sufficient capacity. In the competition for an emptying right of way the capacity demand or calyctic requirement and angle of entrance of the infundibula into the pelvis favored the lower calyces with consequent dilatation of the upper portion of the pyelonephritis being secondary to the stasis.

Pyelograms 18 and 19. G. Q., male, nephralgia left kidney pyelonephritis, left. The "dysuric" upper portion is brought out by the two pyelograms. The "dysuria" is due to a large capacity demand of the upper portion with a small outlet through the true pelvis. It is not functionally a direct continuation of the ureter. The upper portion, functionally has two ureteropelvic junctions: clear instead of one. The upper enters into a cavity already filled with urine and occupied with its own peristaltic duties. These particular pyelograms were made by filling, in Pyelogram 8, rapidly to the point of pain and, in Pyelogram 19, very slowly allowing extracatheter flow to the

lower major calyx which represents the common or true pelvis. They are also shown to present a picture often seen in emptying films. Pyelogram 10 represents what is normally the first pyelographic finding. The catheter is then withdrawn and in 7 or 8 minutes Pyelogram 3 is taken. The lower portion has now emptied leaving the upper full. In this case the condition is partly due to the "dysuric" factors and partly to a temporary paralysis of the smooth muscle produced by the acute overdistention. In similar pelvis, also, when the tip of the catheter terminates in the lower calyx, the pyelographic media may pass to the bladder before filling of the upper major calyx takes place. All of which illustrates the dysfunction of the superior major calyx.

Pyelograms 20 and 21. T. G., male. Pyelonephritis (Bacillus coli) left, normal right kidney. On the left we feel that the drainage facilities of the superior calyx are inadequate due to the smallness and length of its infundibulum as well as to the fact that it enters a pelvis serving the remainder of the kidney. Functionally the superior calyx has two ureteropelvic junctions. The right superior



Pyelogram 23

Pyelogram 25



Fig. 6

calyx has a large infundibulum and is not infected but is potentially dysuric. The slight kinks in the right superior infundibulum, Pyelogram 20, and the left superior infundibulum, Pyelogram 21 are due to overdistention causing approximation of the superior calyx and its common pelvis. Such kinks could occur with a secondary "dysuric" factor.

Pyelogram 22: A. McG., female, aged 25 years. Primipara. Pyelitis of pregnancy (streptococcus). Right pelvic dilatation, not infected, left pelvis infected. From a "dysuric" standpoint this is quite similar to Pyelograms 20 and 21. The superior left calyx suffers stasis with varying degrees of increase in intracalyceal pressure.

Pyelogram 23: M. R., female. Pyelonephritis, bilateral (Bacillus coli). Nephroptosis with pain, right. The "dysuric" point is bilateral and similar to that in Pyelograms 20, 21 and 22. Emptying film in this type of pelvis, taken with patient erect, frequently shows nephroptosis with retention of pyelographic media in the superior major calyx.

Pyelogram 24: W. L. male. Left pyelonephritis (Bacillus coli). Is quite similar to the other pyelograms shown to illustrate this type of "dysuria" except that the superior infundibulum is broader and has a better angle of entrance. It has, however, a minor calyx of considerable output representing a type which, in some instances, could impede the flow down a narrow infundibulum leading from a superior calyx of large capacity demand, through a common pelvis to the ureteropelvic junction.

Pyelogram 25: M. G., female. Tuberculoals of the left kidney. Shows two varieties of long (inadequate) superior infundibula leading from superior calyces of secondary pelvis type and of very considerable capacity demand. Left kidney removed and showed most extensive tuberculous pelvic involvement of the superior portion. The right kidney is potentially "dysuric." Bacillus coli was present in the bladder urine one year after operation. The remaining right side has not been catheterized but is probably infected with Bacillus coli only.

Pyelogram 26: W. E. male. Right kidney normal, "non-dysuric." Shows kink of the superior infundibulum



Pyelogram 24.

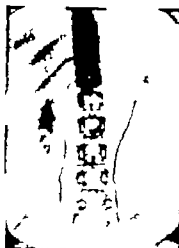
Pyelogram 26

and upper ureter of quite similar degree due to a one degree ptosis and overdistention. The width of the entrance to the superior calyx into the pelvis is unusually broad as is the infundibulum itself.

Fig. 6: Low placed renal sinus with consequent long superior infundibulum with secondary pelvis type of superior major calyx. The infundibulum enters into the common pelvis at or approaching a right angle and may have minor calyces emptying into it, often at right angles also. These two points suggest peristaltic interference along the course and at the emptying point of the calyx. Furthermore, while the long upper infundibulum enters the common pelvis within the renal sinus, its point of entrance is not quite as mobile as though it joined the ureter directly as in Figure 3. On change of position of the kidney this point is subject to kink causing nephralgia and trauma by overdistention of the deeply placed, secondary pelvis type of superior calyx. This type is commonly met with and, as all others, is frequently associated with other "dysuric" factors of pathological importance. The superior ureterocalyceal line is of importance in recognizing this type.

Whether a pelvis either actively or potentially "dysuric" is of interest from a pathological point of view, is determined by ana-

lyzing the pyelogram for one or more of the following drainage interferences. Usually there is one major "dysuric" factor which



Pyelogram 27



Pyelogram 8



Pyelogram 19

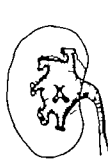


Fig. 7



Fig. 8

Pyelogram 27. H. E. female. Pyelonephritis with intermittent nephralgia. Intrarenal pelvis with large true pelvis but small calyceal capacity. In our experience this type is rare. The nephralgia was apparently secondary to the infection. The slow flow through such a pelvis gives time for multiplication of organisms. An indwelling ureteral catheter is successful in such pelvis in that a common drainage basin is emptied thereby. In many instances a ureteral catheter blocks one portion of a pelvis while draining the remainder.

Pyelogram 18. R. J. male. Represents overdistention with pyelographic media of an extrarenal, small calyceal, large, true pelvic capacity type. Pyelonephritis, no ne-

phralgia. This is the type represented by Figure 8, having in addition a secondary pelvic type of superior calyx of small capacity on a short and relatively narrow infundibulum which, however, does not seem to exhibit a sufficient degree of dysuria to be of importance.

Pyelogram 19. J. O. female, aged 6 years. Acute pyelonephritis. Recovered bacteriologically in a short time. It is easy to feel that there is some stasis in such a pelvis although it is entirely non-dysuric. An unusually large or virulent infection coming through the blood stream or an ascending infection might find favorable reception for at least a longer time than pelvis with more rapid flow.

Figs. 7 and 8. Large true or common pelvis with consequent small calyceal capacity. The large pelvis results in slow emptying particularly at the time of small output. This alone in some instances, constitutes a dysuric factor exactly to the degree that occurs in an early hydronephrosis whether or not it is infected. Figure 7 represents a large, deeply placed intrarenal pelvis with consequent sharp inferior uterocalyceal line. It is more susceptible to secondary "dysuric" factors and also is less distensible without symptoms upon distention than is the corresponding extrarenal pelvis. One seldom has severe pain in this type as the peripelvic fat allows of considerable distention. Figure 8, the large extrarenal pelvis with small calyceal capacity overdistends so readily that the pyelogram usually suggests an early hydronephrosis.

possibly would not be important were it not for some additional minor interference with the flow. The points to be considered are:

1. Placement of the kidney within the body (degree of ptosis or rotation)
2. Shape and size of the kidney (from long and thin to short and thick)
3. Opening of the hilus (high middle low anterior or posterior)
4. Undesirable superior or inferior ureterocalyceal line (formed by the line from the superior minor calyx over the pelvis to the

ureter and by the marginal line from the inferior minor calyx to the lower surface of the pelvis to the ureter respectively). Such lines give indication of the relationship of pelvis to renal hilus and substance as well as of size, shape and position of pelvis and of the influence of these upon the ureteropelvic junction. The inferior ureterocalyceal line shows particularly the depth of the pelvis within the renal substance.

5. The number, size and distribution of the minor calyces and their relationship to the

major calyces (indicating the capacity requirement of the latter)

6 Size and angle of entrance of minor into major calyces and of major calyces into pelvis, and of pelvis into ureter (Artificial dilatation incident to pyelography may alter these angles and sizes) Pelvis dilatibility is of great importance in estimating stasis possibilities

7 Ratio of capacity, shape and location of pelvis to those of the calyces that is the total capacity of major plus minor calyces, and the interdependent capacity requirement and placement of each of these units

The association of two or more of the above 'dysuric' factors even when each is of very moderate degree often produces marked dysfunction of the pelvis Likewise large fluid intake outside pressure, change in position of the kidney or alteration in its blood supply, may institute symptoms when only a moderate degree of drainage deficiency is present

On account of the co-existence of one or more 'dysuric' points in a pelvis a diagnostic classification is presented below in order to stress the major individual 'dysuric' factor The secondary or contributing 'dysuric' factors are discussed in the accompanying pyelograms The latter are intended to emphasize the association of diverse 'dysuric' factors In these pyelograms the diagnosis is mentioned but no type of 'dysuric' pelvis is in our opinion, specific for any one pathological change

FIGURE 1

Bifid pelvis and ureters (complete reduplication)

Pyelogram 1 Pyelogram 2 Pyelogram 3

FIGURE 2

Bifid pelvis with incomplete reduplication of the ureter The ureters draining an upper and lower major calyx which, in capacity and relation to renal substance may be markedly dissimilar to each other

Pyelogram 4 Pyelogram 5
Pyelogram 6 Pyelogram 7

FIGURE 3

Bifid pelvis with the infundibula of the superior and inferior major calyces serving as the ureters as in Figure 2 but joining within the renal sinus and with no common pelvis or only a very small one. Functionally this is quite similar to incomplete reduplication of the ureters.

Pyelogram 8 Pyelogram 9
Pyelogram 10 Pyelogram 11

FIGURE 4

A small kidney pelvis with large calyces capacity

Pyelogram 12 Pyelogram 13

FIGURE 5

Renal sinus entering high with consequent relatively large dependent calyces capacity (A very rare occurrence.)

Pyelogram 14 Pyelogram 15 Pyelogram 16

FIGURE 6

Renal sinus entering at a low level with consequent relatively large superior calyces capacity (Occurring most frequently and in association with many other 'dysuric' factors.)

Pyelogram 17 Pyelogram 18 Pyelogram 19
Pyelogram 20 Pyelogram 21
Pyelogram 22 Pyelogram 23
Pyelogram 24 Pyelogram 25
Pyelogram 26

FIGURE 7

FIGURE 8

Pelves of large capacity but with relatively small calyces capacity Figure 7 Intrarenal, Figure 8 extrarenal in type. This type of pelvis we consider potentially 'dysuric' in that stasis occurs much more readily than in a small pelvic type. The uninfected extrarenal type is more readily distensible without resultant pain or bleeding than the intrarenal.

Pyelogram 27 Pyelogram 28 Pyelogram 29

RELATIONSHIP OF "DYSURIC" PELVES TO RENAL PATHOLOGY

An analysis of the history and pyelogram on 385 cases shows the following significant figures

In 79 cases with normal kidneys but in which pyelographic study was made to rule out kidney or lower urinary tract pathology only 17 showed a "dysuric" type of kidney pelvis In these 17 examples the abnormality was, without exception, of very slight degree

Forty-one cases of renal calculus were studied, 33 having a "dysuric" type of pelvis 4 "non-dysuric" and 4 undetermined There was associated pelvic infection in 14 of the "dysuric" pelvis and in 1 of the 'non-dysuric' type

Of 33 nephralgic kidneys without other demonstrable cause for the pain only 2 were "non-dysuric" the remaining 31 showing varying degrees of 'dysuric' pelvis

In nephroptosis with resultant symptoms the 43 cases showed 29 "dysuric" and 14 "non-dysuric," while the 10 cases which showed an associated infection were all of the "dysuric" type

There were only 11 cases of renal tuberculosis in our series and 9 of these had a dysuric type of pelvis while 1 of the remaining 2 showed so much destruction of kidney tissue that the type of pelvis could not be determined. The remaining case was non-dysuric.

Of 10 examples of idiopathic or essential hematuria 7 had a dysuric type of pelvis and 3 were non-dysuric.

PYELONEPHRITIS

Of 135 cases of pyelonephritis studied 27 could have been complicated by pregnancy. The latter cases have been considered separately and the following discussion concerns only pyelonephritis without other obvious cause of urinary pelvic stasis. We value greatly the many splendid and valuable papers discussing the mode of infection and the routes by which the organism gains entrance into the kidney pelvis. Our consideration is based solely upon the idea that under similar conditions, a non-dysuric pelvis will clear itself of infection more rapidly and in a larger number of instances than will a dysuric pelvis. The damming up of urine in any part of the pelvis permits a constant growth of organisms from which the remainder of the urinary tract may be reinfected. The degree of dysfunction present within the pelvis and ureter all other factors being equal determines the age in life at which kidney symptoms manifest themselves. For example an infant with atresia of the ureteral orifice develops infection early in life while a mild type of dysuric pelvis may develop an essential hematuria late in life.

Undoubtedly a large percentage of cases of pyelitis in infancy recover clinically. In order to determine whether or not they also recover bacteriologically it is necessary to search a specimen of urine which has been incubated within the patient's bladder for from 3 to 6 hours. It is in the type of case in which the patient recovers clinically but not bacteriologically that dysuric pelvises are most important in the prognosis of pyelonephritis. Pelvises potentially dysuric, that is only actively 'dysuric' upon change of position or with the introduction of some

other secondary factor as previously mentioned often show great improvement with bed rest.

Besides the influence of dysuric pelvises we believe that continuation of a pyelonephritis is often due to an interchange of organisms between bladder and pelvis. In the early and acute stages this occurs via the blood stream but in the subacute and chronic stages it may take place via the peri ureteral lymphatics or by direct regurgitation. As the bladder incubates organisms in larger numbers frequent and continued bladder irrigations will often clear up the pyelonephritis when the pelvis is non-dysuric. A pyelonephritis in a markedly 'dysuric' pelvis, while benefited in some instances, does not offer an equal prognosis from bladder treatment alone. In certain dysuric types an occasional pelvic lavage may still be advised to advantage in that less altered ureteral or calyceal physiology may seriously affect the drainage within such a pelvis.

PYELONEPHRITIS OF PREGNANCY

We feel that 'dysuric' kidney pelvises should be added to the other etiological factors frequently discussed in this connection. Their importance lies in the fact that such an imperfect drainage system lends itself more readily to infection even when only very slight back pressure dilatation is present. When a bilateral pyelogram shows a dilated right side to be infected we are much more likely to find the left infected also if it be dysuric and not infected if non-dysuric. We have found the occasional left sided infection in pyelonephritis of pregnancy in the absence of dilatation to be associated with a dysuric left kidney pelvis and explain it on this basis in some instances.

As in simple pyelonephritis the prognosis is affected by the degree of dysuria present. It also seems probable that in such pelvises a low grade infection could have persisted from infancy or childhood to exacerbate in pregnancy.

NEPHRALGIA

A nephralgic kidney lacking discoverable complicating factors can be explained by the existence of types of actively 'dysuric' kid-

ney pelves. In these there is "crowding" of urine either in the entire pelvis or a portion thereof. Of the nephralgic kidneys in our study, the type of actively "dysuric" kidney pelvis encountered most frequently proved to be a very small true pelvis in which the storage capacity was made up of the infundibula and calyces. The pain in this type of "dysuric" kidney pelvis appears to be influenced particularly by large intake of fluid.

The potentially nephralgic kidney most frequently encountered in our analysis was one in which the emptying system of the superior calyx was altered by even a slight change of position resulting in some degree of interference with its emptying. In 2 instances of completely duplicated pelvis and ureters with pain due to interference with ureteral drainage, relief was obtained by resection of the "dysuric" half of the kidney. In both instances we had been able to reproduce the pain complained of by overdistention through a ureteral catheter placed in that part which proved to be the "dysuric" portion. In nephralgic kidneys we believe that the painful period is before dilatation occurs, that is at the time of muscular hyperplasia developed to overcome the slight obstruction. The greater the visible dilatation the more pressure is required, upon retrograde filling, to reproduce pain or bleeding (in the absence of infection). This is due to the dilated weakened muscle and associated pressure anasthesia of the nerve terminals. Intrarenal pelvis, though surrounded by fat and therefore capable of considerable distention, offer greater resistance than extrarenal pelvis and those situated far out on the hilus.

IDIOPATHIC (ESSENTIAL) HEMATURIA

From the standpoint of a "dysuric" pelvis alone we believe that a hematuria can result from identical factors as those set forth under nephralgia. Of the series of 10 cases of idiopathic hematuria 7 showed easily recognizable types of "dysuric" pelvis. The analysis resolves itself into generalized or localized pressure causing rupture of minute or small superficial vessels. Before the period of dilatation a low grade inflammatory change

may be a secondary cause. This low grade infection may be primary or secondary to a mild pelvic and papillary change due to the transient, intracalycine "crowding" of urine which takes place. To account for an essential hematuria by pressure alone, however, a very definite "dysuria" either active or potential must be found, that is, one in which a definite "crowding" of urine occurs within a resistant or inelastic pelvic or calycine wall.

CALCULUS

Stasis is generally accepted as one of the frequent etiological contributory factors in the formation of kidney calculus. We concur in this view. We are also of the opinion that calculus formation can be traceable to the stasis accompanying a "dysuric" pelvis and that the stone forms in that portion of the "dysuric" pelvis in which the greatest "crowding" of urine occurs. In a very high percentage of cases in which stone was found early in life, it occurred in a "dysuric" pelvis. Of the 41 cases studied 33 were in "dysuric" pelvis.

Throughout the analysis of these kidney pelvises it is insistently recurring that familial kidney disease, infection and stone particularly does occur and that it is probably associated with a hereditary tendency to "dysuric" types of kidney pelvis. Why should not the shape of the kidney pelvis associated with the general shape of the kidney, in turn associated with body habitus, be found as frequently constant from a familial standpoint as for example, the shape of the face, nose, etc.?

TUBERCULOSIS

Of 11 tuberculous kidneys 9 were "dysuric". The deep seated pelvis of small capacity with large calycine capacity appeared to be particularly prone to a generalized pelvic tuberculosis. A "dysuric" type of superior calyx became involved frequently without pyelographic evidence of tuberculosis in the remainder of the kidney. Analysis of the 9 "dysuric" pelvises definitely suggests that lack of free drainage in all or in part of the kidney leads to a pelvic type of tuberculosis with secondary parenchymatous spread through that part of the kidney tissue drained by the

most "dysuric" portions of the pelvis. It seemed in every instance that the pelvic tuberculosis was secondary to a primary and older parenchymatous lesion.

NEPHROPTOSIS

We have all been impressed with the fact that a kidney lying in the skeletal pelvis may not be nephralgic whereas one with uncomplicated slight motility may. In our 43 cases of nephroptosis 29 were dysuric. We were not able to make an analysis of statistical value because it was impossible to eliminate all other factors which might have been associated with the nephroptosis in the production of symptoms. We did find definite evidence that no other factor considered, the potentially dysuric kidney pelvis became actively so upon change of position. Most frequently this occurred in conjunction with a change in the angulation of the ureteropelvic junction and is shown by the type of inferior ureterocalycine line or the nature of the junction of the long superior calyx with the superior ureterocalycine line. The more acute the angle between the superior calyx and the pelvis the more prone is the superior infundibulum to kink upon change of renal position. When there is a change in the angulation at the ureteropelvic junction there is crowding of urine or back pressure in the entire pelvis. When it occurs at the junction of the superior calyx and pelvis the crowding is only in the superior portion of the pelvis. Therefore a long narrow kidney with renal sinus set low from a dysuric

standpoint alone is apt to become nephralgic upon a moderate degree of nephroptosis.

Another type likely to become nephralgic upon change of position is the deep seated intrarenal pelvis, indicated by a sharp curving inferior ureterocalycine line. Drainage deficiency or lack of elasticity, or other contributory factors, such as blood vessel or ureteral contact back pressure etc. need be present to a lesser degree in dysuric pelvis in order to cause pain in association with a change in renal position.

CONCLUSIONS

From an analysis of 385 pyelograms and case histories evidence is presented that kidney pelvis generally accepted as normal can be so shaped and so related to the parenchyma as to interfere with the free flow of urine either in the entire pelvis or in a portion thereof. Such pelvis are termed dysuric.

The analysis of the pyelograms on the basis of the dysuric factors described gives *functional individuality* to all kidney pelvis and ureters.

The final importance of such pelvis lies in the fact that they permit urinary stasis in all or in part of the pelvis and that this stasis can be and is of importance in the formation of calculi, the inciting and continuation of infection (simple or tuberculous) and in the etiology of idiopathic haematuria and nephralgia. Application of the facts set forth here are of value in defining the etiology, instituting and continuing the treatment and determining the prognosis in renal pathology.

PROTECTION OF PERITONEUM AGAINST INFECTION¹

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THE work here described presents a method and a material for protection of the peritoneum against varied bacterial contamination. In dogs, this protection is achieved in 12 to 48 hours by a single intraperitoneal injection.

By a method of vaccination previously published (3, 6), little or no protection was afforded by a single injection. A total period of 10 to 12 days and four daily injections of heat killed colon bacilli suspended in physiological saline were required for a maximum protection. Subsequently, it was found (4) that the protection was most probably due to a local peritoneal polymorphonuclear response and a rapid phagocytosis of the organisms. Other experiments (2) had demonstrated that after intraperitoneal introduction of bacteria suspended in physiological saline, the bacteria rapidly pass from the peritoneal cavity into lymph and blood. Consequently because of this rapid disappearance of the saline suspension of bacteria from the peritoneum, the local cellular response was insignificant and no protection was obtained from a single injection of the bacterial suspension. It necessitated several intraperitoneal injections for a sufficient bacterial retention and peritoneal irritation in order to evoke the exudation of enough polymorphonuclears to combat an infection. It was also observed (2) that bacteria suspended in a gum tragacanth solution, when injected intraperitoneally, were retained in the peritoneal cavity.

The following experiments were carried out in order to determine whether heat killed bacteria (our strain colon bacillus No. 300), suspended in gum tragacanth when injected intraperitoneally, would protect animals against various forms of bacterial peritoneal soiling. The injection of the suspension of dead organisms in gum tragacanth solution will be referred to in the following discussion as peritoneal vaccination.

EXPERIMENTAL PROTECTION

The experiments were divided into several groups. In the first experiments the time was varied between the peritoneal vaccination and the infection of the peritoneum with living organisms, to test the degree of protection, but the quantity of the protective substance was kept constant. In the second group of experiments the type of infection was varied but the time factor and the quantity of the infecting substance were kept constant. In the third group, the number of killed bacteria (which constituted one of the two ingredients of the protective substance) was varied. The other ingredient, 1 per cent of gum tragacanth in physiological saline solution, remained constant. The type and amount of infecting substance were kept constant. In the fourth group, the total quantity of both ingredients of the vaccine was increased but the type of infecting substance and the time interval between vaccination and infection were kept constant. The fifth group of experiments constituted controls. Each part of the protective substance was injected separately to test the protective capacity of each ingredient. All the other factors (time interval between vaccination and infection, quantity of material injected, type of peritoneal infection) remained constant.

Group 1. Thirty four dogs were injected intraperitoneally with 50 cubic centimeters of a 1 per cent solution of gum tragacanth in physiological saline in which were suspended heat killed *Bacilli coli* (our culture No. 300, heated at 80 degrees C for 10 minutes). The bacterial suspension contained about 200 million organisms in 1 cubic centimeter. At varying intervals (12, 24, 48, and 72 hours) following this protective intraperitoneal injection, the peritoneum of the 34 animals was infected by an intraperitoneal injection of 40 cubic centimeters of 2.5 per cent gum tragacanth in physiological saline in which were

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TABLE I—RESULTS IN GROUP I

| Interval in hours between vaccination and peritoneal infection | No dogs used | No dogs dead | Percentage survival |
|--|--------------|--------------|---------------------|
| 14 | 5 | 3 | 40 |
| 48 | 20 | 4 | 80 |
| 72 | 19 | — | 80 |
| 72 | 8 | — | 77 |
| Not protected | 16 | 16 | — |

In all of the tables, although the number of animals used is not very large, percentages of survival are given only for the purpose of easier comparison of the results.

TABLE II—RESULTS IN GROUP II

| Character of peritonitis produced | Interval in hours between vaccination and peritoneal infection | No dogs used | No dogs dead | Percentage survival |
|--|--|--------------|--------------|---------------------|
| Intraperitoneal injection of 40 cm. of 5 per cent gum tragacanth with 200 million bacilli per cm. | 48 | 5 | 3 | 80 |
| Not protected | — | 5 | 5 | — |
| Appendix ligated at base perforation made at tip, fecal contents expressed and smeared manually over peritoneum, perforation left open | 48 | 6 | — | 86 |
| Not protected | — | — | — | — |

suspended about 200 million living *Bacilli coli* per cubic centimeter. It was found (Table I) that the 48 hour and 72 hour intervals between the vaccination and the peritoneal infection gave the highest percentage of survivals. When the infecting injection was made 12 hours following the intraperitoneal protective injection only 40 per cent of the animals survived. Twenty six control dogs were not vaccinated but were given the same intraperitoneal injection of living *Bacilli coli* in gum tragacanth as the 34 vaccinated animals. All of the control dogs died.

Group 2 Twenty-one dogs were injected intraperitoneally with 50 cubic centimeters of a suspension of heat killed *Bacilli coli* in 1 per cent solution of gum tragacanth in physiological saline. The bacterial suspension contained about 200 million organisms in 1 cubic centimeter. Forty-eight hours after the protective injection 15 of the animals were infected with an intraperitoneal injection of living organisms (*Bacillus pyocyaneus*, *Streptococcus*

TABLE III—RESULTS IN GROUP III

| No heat killed <i>Bacilli coli</i> suspended per cm. in per cent gum tragacanth | No dogs used | No dogs dead | Percentage survival |
|---|--------------|--------------|---------------------|
| 200,000,000 | — | — | 86 |
| 100,000,000 | 6 | — | 66 |
| 500,000 | 6 | 4 | 33 |
| 20,000 | 6 | 4 | 22 |

fecalis and *Bacillus welchii* isolated from a case of human peritonitis) suspended in a 2 5 per cent gum tragacanth in physiological saline. The bacterial suspension contained about 200 million living organisms more or less evenly divided among the three bacterial species. Of the 15 vaccinated animals, 12 survived.

Eight unvaccinated control dogs were given the same intraperitoneal infecting injection. All died (Table II).

In the 6 remaining vaccinated dogs peritonitis was induced by ligation of the appendix at the base, perforation of the tip and manual spread of the forces over the visceral and parietal peritoneum. The appendiceal perforation was allowed to remain open. In addition to the 6 vaccinated animals, 2 normal dogs were similarly treated by ligating and perforating the appendix. Four of the 6 vaccinated animals survived. The two control dogs died.

Group 3 Twenty-eight dogs were injected intraperitoneally with 50 cubic centimeters of 1 per cent gum tragacanth in physiological saline in which were suspended varying numbers of heat killed *Bacilli coli*. In one group of 10 animals, the protective substance contained about 200 million *Bacilli coli* per cubic centimeter (these 10 animals constituted part of Group 1). In 3 other groups of 6 animals each, the protective substance contained about 1 million 500,000 and 100,000 organisms per cubic centimeter respectively. Forty-eight hours following the protective injection an intraperitoneal injection of 40 cubic centimeters of a suspension of living *Bacilli coli* in 2 5 per cent gum tragacanth was given. The animals vaccinated with the largest number of organisms showed the greatest percentage of survivals. The group vaccinated with the smallest number of organisms had the smallest percentage of survivals (Table III).

TABLE IV—RESULTS IN GROUP IV

| Interval in hours between vaccination and peritoneal infection | No. dogs used | No. dogs dead | Percentage of survival |
|--|---------------|---------------|------------------------|
| 15 | 6 | 0 | 100 |
| 24 | 6 | 0 | 100 |
| Control dogs not protected | 6 | 6 | 0 |

Group 4 Twelve dogs received a protective injection of 100 cubic centimeters of a suspension of heat killed *Bacilli coli* in 1 per cent gum tragacanth in physiological saline. The suspension contained about 200 million organisms per cubic centimeter. Eighteen hours after the protective injection, 6 animals were given an intraperitoneal injection of 40 cubic centimeters of a suspension of living *Bacilli coli* in 1.25 per cent gum tragacanth in physiological saline. Twenty-four hours after the protective injection the 6 remaining vaccinated animals also received the same amount and type of intraperitoneal injection of living *Bacilli coli* in gum tragacanth solution. All of the vaccinated animals survived.

Six control dogs that were not vaccinated received the same intraperitoneal injection of living *Bacilli coli* in gum tragacanth as the vaccinated animals. All of the control animals died.

Group 5 Five dogs were injected intraperitoneally with 50 cubic centimeters of 1 per cent gum tragacanth in physiological saline. Five other dogs were injected with 50 cubic centimeters of a saline suspension of heat killed *Bacilli coli* containing 200 million organisms per cubic centimeter. Forty-eight hours following these intraperitoneal injections the peritoneum of the 10 dogs was infected by the intraperitoneal injection of 40 cubic centimeters of a suspension of living *Bacilli coli* in 2.5 per cent gum tragacanth. The 10 dogs died (Table V).

Examination of animals. All of the dogs that survived the peritoneal infection were eventually killed and examined. In addition 10 dogs were killed which had received only 50 cubic centimeters of the protective material. One dog from every group was killed every week. A small amount of exudate persisted in some dogs for a month. Of the 10 vaccinated animals that were not given an

TABLE V—RESULTS IN GROUP V

| Type of material used for protection | N dogs used | No. dogs dead | Percentage of survival |
|---|-------------|---------------|------------------------|
| 1 per cent gum tragacanth in physiological saline | 5 | 1 | 0 |
| A suspension of heat killed <i>Bacilli coli</i> in physiological saline | 5 | 5 | 0 |

infecting intraperitoneal injection, none had peritoneal adhesions. Of the groups of vaccinated animals that also received the infecting intraperitoneal injection, a few of the animals showed slight adhesion of a loop or two of bowel to the abdominal wall. Gross and microscopic examination of the viscera failed to show any striking abnormalities.

MECHANISM OF PROTECTION

The reactions within the peritoneal cavity were investigated by hourly withdrawal of the peritoneal exudate. This was done by piercing the abdominal wall with a glass capillary pipette. Cell counts were made by means of the standard white and red blood cell pipettes and counting chamber. Bacteria were counted by the dilution and plating method (1). The type of cell, the differential counts and the degree of phagocytosis were determined from stained films (Wright's stain and methylene blue).

The following protocol will serve as an illustration of what happens in the peritoneal cavity following the intraperitoneal injection of heat killed *Bacilli coli* in 1 per cent gum tragacanth. This series of events was studied in 16 animals and was similar in all.

A dog was given intraperitoneally 50 cubic centimeters of a 1 per cent solution of gum tragacanth in physiological saline in which were suspended about 200 million heat killed *Bacilli coli* per cubic centimeter. The number of white cells in the peritoneal exudate was counted at hourly intervals following the injection. Up to the fourth hour there was a gradual increase in the number of polymorphonuclear leucocytes. After that the number vacillated but continued generally to rise (Chart 1). The reason for this fall and rise of polymorphonuclears will become apparent in the later experiments. In 10 hours the white cell count in the peritoneal exudate rose to

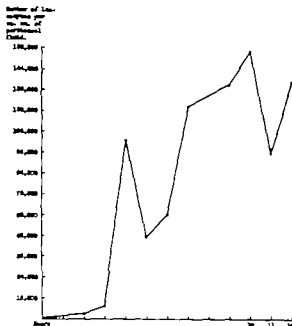


Chart 1: Hourly white cell counts of the peritoneal exudate (per cu. mm.) in a dog which received intraperitoneally 50 cubic centimeters of a 1 per cent gum tragacanth in physiological saline in which were suspended about 200 million heat killed *Bacilli coli* per cubic centimeter.

153,000 per cubic millimeter. In 24 hours, the count was 240,000 and in 72 hours 460,000. The white cells persisted in appreciable numbers in the peritoneal cavity for 26 days. At the end of the first week there were 52,200 cells at the end of 16 days 124,000 and on the twenty-sixth day 31,600 cells per cubic millimeter of peritoneal exudate. For the first 48 hours the cells were predominantly polymorphonuclear in type. In 72 hours and from then on there was an appreciable increase in the mononuclear and a decrease in the polymorphonuclear type.

The following protocols will serve as an illustration of what happens in the peritoneal cavity when a peritoneally vaccinated animal is given an intraperitoneal injection of living *Bacilli coli* suspended in gum tragacanth.

Two dogs were vaccinated by the intraperitoneal injection of 50 cubic centimeters of 1 per cent gum tragacanth in physiological saline in which were suspended about 200 million heat killed *Bacilli coli* per cubic centimeter. Forty-eight and 72 hours later respec-

tively the peritoneum was infected by the injection of 40 cubic centimeters of a suspension of living *Bacilli coli* in 2.5 per cent gum tragacanth. At the end of 1 hour, peritoneal cell counts of the two animals showed a marked decline in the number of cells compared with the number present in the peritoneal cavity prior to the injection of the suspension of living organisms (from 266,000 and 537,500 to 13,500 and 8,500 respectively). At the end of the second and third hours the cell counts had increased greatly and from then on there was a fall and rise in the number of cells (Chart 2). The bacterial count of the peritoneal exudate showed a great decrease in the number of viable bacteria in 1 hour following the infection of the peritoneum (Table VI). The fall and rise of the number of cells corresponded more or less with the fall and rise of the number of bacteria. The examination of stained films of peritoneal exudate disclosed at the end of the first hour practically complete phagocytosis of the bacteria with very few organisms free in the fluid of the exudate. However at the end of the third hour of the many polymorphonuclears which were present only a few (about 5 per cent) contained phagocytosed bacteria, and there were many degenerated cells.

From the correlation of the peritoneal cell counts, the bacterial counts and examination of stained films, it is assumed that the fall in the number of the polymorphonuclear leucocytes is due to two factors: (a) degeneration of the cells, and (b) the passage of cells with phagocytosed bacteria from the peritoneal cavity into the lymphatics and blood vessels. The subsequent rise in the number of cells is accounted for by the passage of new polymorphonuclears in the exudate from the vessels into the peritoneal cavity. The presence of young forms and bacteria free cells in the stained films are evidence in favor of this assumption.

The type of cell which was phagocytic for bacteria was the polymorphonuclear. The mononuclear type of cell (monocyte, clasmacyte) was present in small numbers at the onset of infection and did not increase until the living bacteria had practically disappeared from the peritoneal cavity.

TABLE VI—BACTERIA COUNTS

Counts of living bacteria in the peritoneal exudate of two vaccinated dogs and one unvaccinated dog after peritoneal injection with a suspension of living *Bacillus coli* in gum tragacanth solution.*

| Hours following peritoneal infection | Bacteria per c.c.m. of peritoneal exudate is | | |
|--------------------------------------|--|---|---|
| | Control unvaccinated dog | Dog vaccinated 48 hrs. before infection of peritoneum | Dog vaccinated 72 hrs. before infection of peritoneum |
| 1 | 27,000,000 | 500 | 150,000 |
| 2 | 22,000,000 | 2,000 | 2,000 |
| 3 | 24,000,000 | 2,100 | 1,000 |
| 4 | 6,750,000 | 2,200 | 10,000 |
| 5 | 830,000 | 7,000 | 11,000 |
| 6 | 549,000 | 7,500 | 2,000 |
| 7 | 750,000 | 2,500 | 6,000 |
| 8 | 14,000,000 | 1,500 | 2,000 |
| 9 | 20,300,000 | 200 | 7,000 |
| 10 | 4, 50,000 | 2,000 | 0,000 |

*The number of living bacteria in the suspension used for the infection of the peritoneum was in every case about 200,000,000 per c.c.m.

CLINICAL APPLICATION

In 100 patients, from 12 to 48 hours prior to surgical operation an intraperitoneal injection consisting of a suspension of *Bacilli coli* No 300 in 1 per cent gum tragacanth in physiological saline, was given. The injection consisted of 30 cubic centimeters of this suspension which contained about 200,000,000 organisms per cubic centimeter. The point of injection was in the midline, a little below the umbilicus. The urinary bladder was emptied by the patient prior to the injection. The needle used was No 15 gauge, 2 inches long to insure penetration of the abdominal wall.

One half hour prior to the intraperitoneal injection, one-sixth to one-quarter grain of morphine sulphate was given and repeated at 4 hour intervals for 16 hours. The reactions (abdominal pain and slight elevation of temperature) are those of a peritoneal irritation and the former can be controlled with morphine. The protective substance was administered in cases in which there was danger of peritoneal soiling resection of intestine (especially large bowel) intestinal anastomosis 'interval' appendectomy, chronic pelvic conditions with adhesions requiring removal of pelvic organs. A definite contra indication to

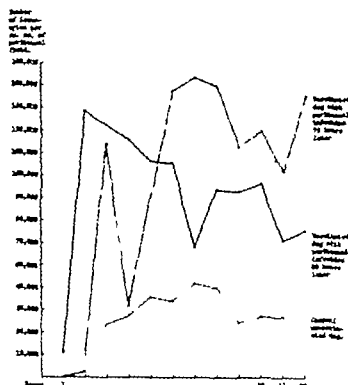


Chart 2. Hourly white cell counts of the peritoneal exudates (per cu. mm.) in dogs which received intraperitoneally 30 cubic centimeters of 1 per cent gum tragacanth in physiological saline in which were suspended about 200 million heat killed *Bacilli coli* per cubic centimeter. Forty-eight hours and 72 hours later each dog respectively was given intraperitoneally 40 cubic centimeters of a 5 per cent gum tragacanth in physiological saline in which were suspended about 200 million living *Bacilli coli* per cubic centimeter. The peritoneal cell counts of an unvaccinated control dog with a similar type of peritoneal infection is included to show the relative number of cells in protected and unprotected dogs. Count before infection in vaccinated dog with peritoneal infection, 266,000, 48 hours later 537,500 72 hours later

the use of this method is an already developed and clinically demonstrable general peritonitis. A detailed report of this phase of the work will be given at a later date. Of the 100 patients treated to date none developed acute peritonitis.

As an interesting illustration the following case is cited. A patient with an annular carcinoma of the colon was protected 18 hours prior to the operation. During the operative procedure the bowel was torn and feces escaped into the peritoneal cavity. The patient did not develop peritonitis.

DEDUCTIONS

The factor responsible for the protection of the animals with the killed *Bacillus coli* gum tragacanth mixture is apparently predomi-

nantly phagocytosis by polymorphonuclear leucocytes. The introduction of the protective substance and its retention in the peritoneal cavity evoke the exudation of a large number of polymorphonuclears which are available for phagocytic action at the time of the infection. This phenomenon has been designated by one of us (5) as "hyperleukocytic preimmunity."

This protection must be regarded as non-specific since the protective material was effective not only against the *Bacillus coli* but also against the *Bacillus pyocyaneus*, *Streptococcus faecalis*, *Bacillus welchii* and other organisms found in feces. After the non-specific character of the protection was determined *Bacillus coli* gum tragacanth peritonitis was used throughout the experiments as the test for the existence of protection because it is an easily controlled standard procedure. The particular organism and strain (*Bacillus coli* No. 300) was used as protective substance because it happened to be excellent for the production of hyperleukocytosis in the peritoneal cavity.

There is an apparently direct quantitative relationship between the amount of the protective substance used, and the percentage of survival of the animals. Larger amounts of the substance resulted in a greater percentage of surviving animals. Neither one of the components of the protective material singly could

protect against a fatal outcome when the infecting injection was made within 72 hours.

CONCLUSIONS

1. A material and a method are presented for the protection of the peritoneum against infection. In dogs, a single intraperitoneal injection is effective within 12 hours, against peritoneal infection with *Bacilli coli* and other intestinal bacteria which are often found associated with acute peritonitis.

2. The material acts by evoking a polymorphonuclear hyperleukocytosis and a consequent rapid phagocytosis of living organisms.

3. This method of protection has been used clinically in 100 cases of possible peritoneal soiling at operation. Although the number of cases is too small for a positive determination of the protective effect, yet it is noteworthy that none of these patients developed peritonitis.

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EPITHELIOMATA OF THE LOWER RECTUM AND ANUS

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ONE is surprised at the infrequent reference in modern medical literature to the group of ano-rectal epitheliomata for, although rare, these tumors comprise a well known pathological entity. Textbooks of rectal surgery allude to them as members of the pernicious group of rectal neoplasms but detailed descriptions of their clinical and pathological characteristics are negligible. It is true that only a small percentage of all gastro-intestinal neoplasms are of this nature. Pack places their incidence at 3 to 4 per cent of all rectal cancer and the few other investigators who have ventured to refer to their frequency have agreed that the incidence is less than 5 per cent. Among the 352 proved malignancies of the rectum in the files of the Presbyterian Hospital only 10 or 2.8 per cent, were of squamous cell nature.

Feeling that this group of tumors should occupy a more prominent place in the description of gastro-intestinal neoplasms the author has attempted an analysis of these 10 cases from the standpoints of clinical features, pathology, prognosis and treatment. The results of this study form the basis for the following paper.

HISTORICAL

Epitheliomata of the anus and rectum have undoubtedly long been known as pathological lesions of the terminal bowel but it is questionable if the earlier pathologists and surgeons realized the malignant nature of the lesion and treated it as more than a simple ulcer or polyp. Reviewing the sparse literature on the subject one comes across few descriptions of the tumor until the latter half of the nineteenth century. Much more common however were the chronic ulcers and fissures which persistently refused to heal in spite of local treatment and in which the patients frequently succumbed to cachectic disease. Bushe records one of the earliest malignant epitheliomata of the anus which, because of

the inefficiency of treatment at that time terminated fatally. Allingham, in 1879, commented upon the rarity of the lesion but it is quite probable that he mistook many of the neoplasms for benign rodent or lupoid ulcers. Several of the latter which he described caused death from the late effects of the disease a fact which must have signified metastases and extension. In spite of Lisfranc's earlier work on resection of the rectum, Allingham regarded operative procedures as hopeless and deforming and preferred to treat the condition primarily along palliative lines. Van Buren was one of the first to give a lucid description of the growth and commenting upon its similarity to squamous cell cancer of the lip advised excision as a hopeful measure in early cases. The subsequent experience of surgeons at large has contributed little to the subject in general and many regard the entity as an insidious and hopeless condition in the majority of cases. The increasing use of radium and X ray therapy has brightened the outlook in epitheliomata and some investigators are exceedingly optimistic regarding the results after interstitial radiation.

OCCURRENCE

The number of cases in this series is so small that conclusive deductions cannot be drawn as to their distribution between the sexes and races and the ages at which they occur. The following statements are therefore referable only to the cases observed in this clinic and should not be regarded as generalities.

The white race was more susceptible to the condition the ratio of whites and blacks affected being four to one. It should be recalled, however that white people come under hospital observation more commonly than do negroes. Only 2 of the 10 patients were males. This is a surprising and interesting finding in view of the general prevalence of gastro-intestinal cancer among males but this

too cannot be considered a constant feature of the disease unless borne out by a large number of cases. Unfortunately the cases reported in the literature are so few that such a positive deduction would be erratic. The age distribution corresponded roughly to that of carcinoma elsewhere in the body the average age being 48 7 years.

ETIOLOGICAL FACTORS

Little can be authoritatively said in regard to the etiology of any malignant growth. As irritation has come to be regarded as a contributing factor in cancer of the oral cavity however so has a similar influence been recognized in epitheliomata of the anus. Fistures, fistulas and chronic ulcers are among the common lesions from which anal malignancy is thought to develop. Many pathologists claim to have observed true cancer developing in the bases of such lesions and in many other incidences the two conditions have been reported coincidental. In still other cases the tumors have been said to have developed in the sudoriferous or sebaceous glands cicatrices moles or psoriatic patches. Proof of the relationship between such so called precancerous lesions and fully developed malignancy however is still lacking and must be considered as a matter of conjecture. Overexposure to X rays has been considered the definite stimulating factor in many cases of skin cancer and it is therefore logical to assume that epitheliomata of the anus can be produced in the same way. Such was thought to be the agent in one of the cases in this series and will be discussed more fully in a later section of the paper.

Gant has attempted to trace the development of the anal epithelioma through its various stages. According to his hypothesis the forerunner of the tumor or the precancerous lesion is the small papillary excrescence or the benign ulcer. This in its process of growth forms the nodular indurating tumor which in turn gives rise to the large indolent ulcer the typical epitheliomatous manifestation. Correlation with the microscopical findings is not in complete accord with this theory and shows that these various gross forms signify different histological tumor types.

In résumé one can assume that since irritative lesions frequently precede and accompany epitheliomata, they may play an important rôle in the development of the latter. To designate which is cause and which is effect is more difficult and to state dogmatically that such lesions are the etiological agents of cancer would be extremely didactic.

CLINICAL ASPECTS

Clinical recognition of the lesion is facilitated by its accessibility although diagnosis of the malignant nature is particularly difficult in the early stages.

Pain is the most constant and depressing feature of the condition and may be of two types. Tumors producing infiltrating subcutaneous masses cause a dull pain which is aching boring or throbbing in character. Sedatives provide some relief but the patient is constantly aware of a heavy sensation in the lower pelvis which bowel evacuation fails to relieve. If on the other hand the surface of the tumor is ulcerated the frequent irritation of passing fecal material or the cleansing process following a bowel movement produces an intense burning pain comparable to that of fissure. Itching not infrequently precedes the onset of actual pain by weeks or even months and the irritation and excretion produced by the patient's attempts to relieve himself are no doubt contributory to the course of the disease.

Bleeding is a common symptom and is characteristic of low rectal growths. It occurs when the tumor is ulcerated. Fresh and bright red in color it is usually recognized by the patient as streaks of blood on the stool or as spots upon the undergarments. Copious hemorrhage or tarry stools rarely occur. In the majority of cases the growth is located outside the anus or near enough to enable the patient to recognize an unusual mass or ulcer by palpation. On many occasions this may be the first warning of any pathology.

Symptoms of obstruction can be produced if the marginal growth forms a cicatrix about the anal aperture. More rarely low intra rectal growths plug the anus from above by a ball-valve effect. In either event the obstruction is characterized more frequently by

tenesmus and a sensation of heaviness in the pelvis than by distention and meteorism.

Constitutional symptoms appear late after the disease has become well established. Loss of weight may be more or less marked but secondary anemia and cachexia are less pronounced than in the case of large bowel malignancies.

The physical manifestations are usually sufficiently characteristic to make the diagnosis. The general appearance of the patient does not always show the devastating effects of malignant disease if the condition is in its early stage. Emaciation and debility are rarely marked unless the growth is of long duration and has undergone extensive metastases.

The appearance of the lesion itself is usually characteristic but varies somewhat with the type of growth and the degree of malignancy. The small papillary excrescence is perhaps the earliest and most benign form. It resembles a condyloma or venereal wart and the differentiation is sometimes difficult. At other times the tumor appears as a small peri anal ulcer no more than a few millimeters across with an excavated center and a hard indurated base. This latter forms the extensive indolent ulcer similar to certain forms of epitheliomata elsewhere on the body if allowed to grow unmolested. This ulcer has a hard, granulating base with raised and overhanging edges. The area bleeds easily to touch and exudes a foul smelling seropurulent fluid.

The less common manifestation of the lesion is a nodular warty growth which usually begins near the anal margin later extending out into the peri-anal tissues producing an irregular deformity of the skin. Pressure is painful accentuating the dull pain from which the patient is a constant sufferer. If the tumor originates inside the anal orifice or extends deep into the tissues of the ischio-rectal fossa, it may not be apparent to external examination. In this event digital palpation usually reveals the mass as a definite tumor or a sense of resistance outside the lumen especially when counter pressure is applied to the perineum with the other hand.

Laboratory findings show little of signifi-

cance and, indeed, these are not essential to diagnosis. A moderate secondary anemia is the rule. If the tumor is ulcerated and secondarily infected a slight leucocytosis is to be expected. X-ray findings have little to offer due to the superficial location of the growth. Biopsy is, of course, the most valuable laboratory procedure and is the only certain means of differentiating a malignant tumor from a benign lesion.

DIAGNOSIS

The diagnosis of epitheliomata by means of biopsy is relatively easy but on the basis of clinical observation alone the condition must be differentiated from several other lesions.

Non specific ulcers lack the hard cartilaginous base characteristic of the malignant epithelioma and tend to regress under local treatment. *Tuberculosis* not infrequently forms cutaneous ulcers or may even produce a tumor or stricture low in the rectal canal. It may be a source of diagnostic confusion but is softer and is usually coincident to tuberculosis elsewhere in the body. Certain forms of *eczema* are not infrequently confused with the precancerous scaly keratosis especially when irritated. *Fissures and fistulas* because of their insidious manner of growth are a source of common error in diagnosis. Differentiation is all the more difficult since the relation between the two is still a moot question. *Venereal warts and condylomata* are grossly similar to some types of epitheliomata but thorough laboratory study should rule these out.

Other types of tumor growth about the anus often necessitate biopsy for diagnosis. *Carcinomata* arising from the lower rectum and extending away from the bowel lumen infiltrate the subcutaneous tissue and form palpable lumps beneath the peri anal skin. *Epitheliomata* of the perineal skin may extend to and involve the anus secondarily. *Melanomata* are not grossly unlike true squamous cell epitheliomata except when the characteristic bluish black color is evident. Among the rarer conditions encountered are peri anal *lymphangiomata*, *endometriomata* of the recto-vaginal septum in females, *cysts and tumors* of the portanal gut *anomalies* of the procto-

denum and coccygeal vestiges Old *hemorrhoids* of long standing which have become fibrosed may acquire a firmness suggestive of malignancy but in this case a history of long duration should rule out the latter condition.

PATHOLOGY

Gross The gross forms commonly assumed by epitheliomata of the lower rectum and anus have been alluded to in a previous paragraph. Regarding their location they may be divided into *internal* and *external* growths according to their origin from within or without the anal sphincters. From the point of view of morphology they may be classified as *nodular* or *ulcerating*.

Internal epitheliomata are most apt to arise and extend upward from the mucocutaneous junction although it is apparently possible for tumors of this type to develop from a metaplasia of the cells of the mucosa. One case of this type in the sigmoid colon was observed by the author. Such a location can only be explained by a cellular metaplasia which there is reason to believe is brought about by irritative influences upon what would otherwise have been a columnar cell tumor. The nodular type of growth above the sphincters expands intramurally forming a flat irregular plaque or it may grow in an extraluminal fashion into the perirectal tissues without obstructing the bowel. A pedunculated intraluminal tumor may result the pedicle of which becomes so elongated by passing fecal contents that it is extruded with bowel movements to be manually replaced by the patient. When ulcerated the tumor grossly resembles an adenocarcinoma but does not exhibit the tendency to grow in the characteristic annular fashion of the latter. The papillomatous form is not unknown and resembles grossly a benign adenoma.

The more common *external* epitheliomata are easily divided into the two mentioned classes. The ulcerated forms first appear at the anal margin and later extend out over the perianal skin. They are surrounded by raised indurated edges and have dirty white or granulating bases. A cut section through such an ulcer shows that it has a hard white cartilaginous base which offers a definite re-

sistance to the knife. Irregular prolongations extend downward from it into the underlying tissues. The nodular type of growth may as has been suggested represent an early stage of the ulcerating epithelioma but in the majority of cases it is believed, signifies a different histological tumor type. From the cutaneous surface the tumor appears as a growth which attached to the skin raises it in irregular nodules or retracts it in puckered ridges. The cut section shows a lobular invasion of the subcutaneous and submucous tissues arising from and thickest just beneath the epidermis. The more benign epitheliomata not uncommonly grow in a polypoid shape as illustrated in Figure 1.

The so called precancerous lesion has no characteristic gross appearance. If it be a pre-existing ulcer fissure fibrosed hemorrhoid or excrescence there is nothing to make one suspect the presence of malignant change save perhaps an increased firmness and only by microscopical examination can the cancer be detected.

Metastases from anal epitheliomata usually appear first in the inguinal nodes, later involving the glands of the perirectal tissues and the mesorectum. Rarely are they found in distant parts of the body. This local distribution of secondary growths indicates that in all probability the deposits of cells are carried by the lymphatic channels rather than the blood stream. The distribution of metastases is explained by the course of the lymph vessels supplying the anal region. The most external portion of the anus is drained by a group of vessels which course forward in the crurascrotal region to the upper and lower tiers of inguinal nodes. Other smaller branches have been demonstrated following the gluteal fold to the same groups of nodes. The region of Hilton's white line and the lower rectum is supplied by channels following the inferior and middle hemorrhoidal blood vessels. The former anastomose with the lymphatics supplying the rectovaginal septum and account for the occasional extension of tumors to this region. Other small branches from the lower rectum accompany the middle and superior hemorrhoidal blood vessels. Metastases may therefore reach the mesorectal and sacral

glands in this manner, but since the majority of epitheliomata are situated below the latter region, these vessels are not the first to be invaded.

Microscopic Histologically the epitheliomata of the anus are somewhat like malignant hyperplasia of the skin and mucous membranes elsewhere in the body. The tumor cells invade the basement membrane first as extensions of the malpighian pegs and later as individual ramifications, extending through out the subcutaneous and submucous tissue. The manner of growth during this process of invasion differentiates two types of tumor. In the following discussion one type shall be referred to as the *diffuse* growth and the other as the *discrete* growth.

The cells of the diffusely growing tumor invade the tissue destroying the normal architecture and branching in every direction. They are extremely irregular in size the nuclear diameters varying from 5 to 18 microns. The cells membranes are indistinct. The cytoplasm is faintly acidophilic and the nuclei appear as large, grayish rings rimmed with numerous chromatin particles. Mitotic figures are not especially numerous being found in from 1 to 2 per cent of the nuclei but varying in different parts of the growth. Epithelial pearls are common but vary with the age of the tumor. The keratinization is sometimes so profuse as largely to supplant the actively growing cells. The stroma is composed of loose fibrous connective and granulation tissue packed with leucocytes and small round cells. This type of cell structure is common to the ulcerating epitheliomata previously described and is illustrated in Figures 3, 4, 5 and 6.

The second type of epithelioma as depicted in Figures 7 to 10, inclusive, presents a slightly different cell morphology. The cells are attached to the malpighian pegs in the same manner but form discrete nests and strands separated by a dense connective tissue stroma. They are smaller and more regular in size, the nuclei varying from 4 to 10 microns in diameter. The cytoplasm takes a darker stain and is better differentiated. The nuclei are likewise darker and mitotic figures are found in as many as 6 per cent. Occa-

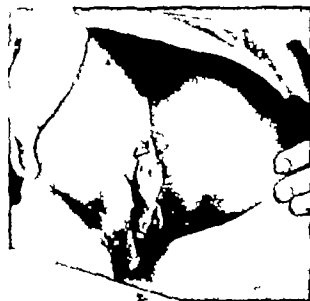


Fig. 1 Case 5 Path. No. 23,880. Gross photograph of a nodular epithelioma of the anus. The growth was pedunculated but had infiltrated the surrounding skin and the presence of inguinal metastases belied the appearance of low grade malignancy.

sional giant cells are observed but no inter cellular bridges or evidence of keratinization can be seen. This form resembles strikingly the basal cell carcinomata described by Krompecher and from the microscopical appearance alone the differentiation would be difficult. When correlated with the gross findings, however, it is found that the discrete type of epithelioma assumes the nodular gross form in contradistinction to the "rodent ulcer" of the face. Furthermore in the available follow up data on this series of patients it was found that these tumors were more malignant as judged by the reappearance of the growth following excision. A resemblance may be noted between this type of epithelioma and the ramifying squamous cell carcinomata of the cervix uteri, both in the manner of growth and cellular differentiation. Furthermore their behavior suggests a similar grade of malignancy.

TREATMENT

The treatment of anal epitheliomata has never been regarded as adequate. Surgeons early recognized in them a peculiarly resistant type of tumor. Accordingly in spite of the optimism accompanying the innovation of applicable surgical procedures palliative treatment was preferred to a mutilating operation which in the majority of cases would fail to

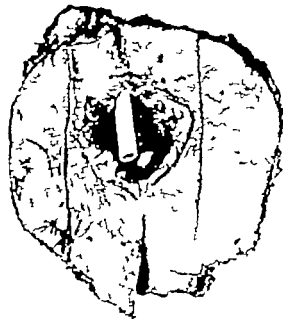


Fig. Case Path N. 37,679. Photograph of specimen removed from epithelioma of the anus. This tumor was of the ulcerating type and had completely destroyed the anal aperture. The pointer is in the continuation of the anal canal. A combined abdominoperineal resection was performed, a wide margin of normal tissue being removed. The patient is well 4 years later without sign of reappearance.

effect a cure. Nevertheless, with the gradual perfection of operative technique excision has come to be regarded less pessimistically and although the ultimate results leave much to be desired many now regard surgery as the only hope for permanent cure.

The early localized nodule or peri-anal ulcer is most favorable from the standpoint of curability. Even in these the mistake of conservatism is a common one. Although the growth is small and well localized the best results have been obtained by wide excision without regard for preservation of the sphincter. This may suffice for a cure but the large ragged defect requiring months for healing and resulting in partial or total loss of sphincter control frequently causes the patient to feel that the cure is worse than the malady.

In recent years, eminent surgeons have come to favor the combined abdominoperineal op-

eration even though the growth be small and well circumscribed. That such a radical procedure is at least partially justified is shown by the fact that the only favorable late result in this series from operation alone followed an operation of this type. This patient (Case 2) has lived 4 years after operation without signs of reappearance.

The question of routine inguinal gland dissection must necessarily be considered. This is not infrequently advocated regardless of the evident lack of metastases. The rationale of this procedure must be questioned. If the tumor cells have not begun to spread through the lymphatics it is obvious that little will be accomplished by the dissection. If metastasis has already taken place either grossly or microscopically it is hard to conceive of the total elimination of danger since one can by no means be certain of removing all communicating lymph channels even if all affected glands are removed. To accomplish this satisfactorily the operator would be forced to remove a tremendous amount of subcutaneous tissue not only along the crurascrotal fold but from the gluteal fold as well. Furthermore extension to the inguinal glands rarely occurs until the primary growth is in a hopelessly advanced condition.

The status of irradiation in anal epitheliomata, either alone or as an adjunct to surgical extirpation has not been sufficiently established to enable one accurately to evaluate its use. Among many other tumor groups these neoplasms have been radiated in so few instances that it is impossible to gather enough statistics to justify conclusive deductions. Monod of the Institut du Radium in Paris considers them more radiosensitive than carcinomata of the rectum. Gordon Watson of London compares the sensitivity of the tumor to that of epitheliomata of the tongue and although he is optimistic over the results of a few personal cases, hesitates to regard any patient treated by irradiation alone as permanently cured. As is so often the case when other methods have failed X-ray therapy and radium have been used as a last resort.

Four of the cases in this series received some form of radiation. In Case 1 patient received heavy external radiation alone and is appar-



Fig. 3. Case 1, Path. No. 43,337. Low power photomicrograph of a diffuse epithelioma of the anus. Note the frequency of epithelial pearls and the irregularity in the growth of the cells. The stroma is scant and composed of a delicate meshwork of connective tissue fibers.



Fig. 4. Case 1 Path. No. 43,337. High power photomicrograph showing keratinization, irregularity of cells, and absence of mitotic figures. This tumor reacted well to external radiation and the patient is apparently well 5 years after treatment.

ently well today 2 years after the initial appearance of the lesion. In Case 4 patient was treated by local application of radium together with a series of 25 exposures to X rays. The course of the growth was temporarily checked and the symptoms partially relieved, but death followed from metastases. In Case 5 patient received 35 X ray treatments following palliative excision of the growth. She lived 3 years and was relatively symptom free until the last 6 months. The fourth patient, Case 6 was given a local application of the radium pack but became unco-operative and left the hospital. The ultimate result was not obtained.

Binkley, of the Memorial Hospital, in New York, reports 1 case in which the patient lived 7 years after irradiation alone without reappearance of the primary growth, but died from widespread metastases. Two others seen by him are apparently well at present following irradiation alone. He advocates heavy external radiation in preference to the interstitial method because of the severe reaction which not infrequently follows the latter. He feels that this followed by excision constitutes the most favorable mode of treatment.

The experience of Lenz at the Presbyterian Hospital supports Binkley's observations. He alludes to a most important factor frequently overlooked in the irradiation of tumors elsewhere in the body namely the choice of time for the institution of X ray therapy. Post-operative scar tissue has low resistance to X rays and in order to prevent breaking down and radio-necrosis the dosage must be curtailed to the extent that it is frequently ineffective. To accomplish the desired result upon the tumor, massive doses are necessary. Hence Lenz advocates pre-operative irradiation in practically all instances.

To summarize we may say that anorectal epitheliomata are more radiosensitive than carcinomata of the rectum but that a permanent cure can be effected by this means is a matter of doubt. Irradiation prolongs life and ameliorates symptoms and for this reason should be emphasized in the treatment of inoperable growths. Although the primary tumor may not reappear, the growth shows a tendency to metastasize late to the inguinal nodes. It is thought that heavy external radiation followed by radical excision constitutes the best means of treatment.

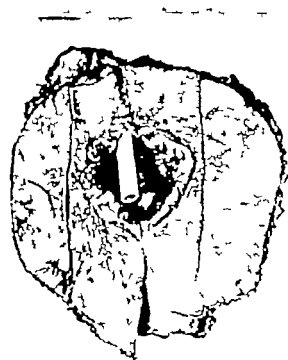


Fig. Case Path N 37,670 Photograph of specimen removed from epithelioma of the anus. This tumor was of the ulcerating type and had completely destroyed the anal aperture. The pointer is in the continuation of the anal canal. A combined abdominoperineal resection was performed, a wide margin of normal tissue being removed. The patient is well 4 years later without sign of reappearance.

effect a cure. Nevertheless with the gradual perfection of operative technique excision has come to be regarded less pessimistically and although the ultimate results leave much to be desired many now regard surgery as the only hope for permanent cure.

The early localized nodule or perianal ulcer is most favorable from the standpoint of curability. Even in these the mistake of conservatism is a common one. Although the growth is small and well localized the best results have been obtained by wide excision without regard for preservation of the sphincters. This may suffice for a cure but the large ragged defect requiring months for healing and resulting in partial or total loss of sphincter control frequently causes the patient to feel that the cure is worse than the malady.

In recent years, eminent surgeons have come to favor the combined abdominoperineal op-

eration even though the growth be small and well circumscribed. That such a radical procedure is at least partially justified is shown by the fact that the only favorable late result in this series from operation alone followed an operation of this type. This patient (Case 2) has lived 4 years after operation without signs of reappearance.

The question of routine inguinal gland dissection must necessarily be considered. This is not infrequently advocated regardless of the evident lack of metastases. The rationale of this procedure must be questioned. If the tumor cells have not begun to spread through the lymphatics it is obvious that little will be accomplished by the dissection. If metastasis has already taken place either grossly or microscopically it is hard to conceive of the total elimination of danger since one can by no means be certain of removing all communicating lymph channels even if all affected glands are removed. To accomplish this satisfactorily the operator would be forced to remove a tremendous amount of subcutaneous tissue not only along the crurascrotal fold but from the gluteal fold as well. Furthermore extension to the inguinal glands rarely occurs until the primary growth is in a hopelessly advanced condition.

The status of irradiation in anal epithelioma, either alone or as an adjunct to surgical extirpation has not been sufficiently established to enable one accurately to evaluate its use. Among many other tumor groups these neoplasms have been radiated in so few instances that it is impossible to gather enough statistics to justify conclusive deductions. Monod of the Institut du Radium in Paris considers them more radiosensitive than carcinomata of the rectum. Gordon Watson of London compares the sensitivity of the tumor to that of epitheliomata of the tongue and although he is optimistic over the results of a few personal cases, hesitates to regard any patient treated by irradiation alone as permanently cured. As is so often the case, when other methods have failed X-ray therapy and radium have been used as a last resort.

Four of the cases in this series received some form of radiation. In Case 1 patient received heavy external radiation alone and is appar-

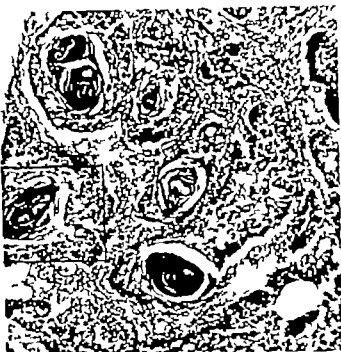


Fig. 3. Case 1, Path. No. 43,337. Low power photomicrograph of a diffuse epithelioma of the anus. Note the frequency of epithelial pearls and the irregularity in the growth of the cells. The stroma is scant and composed of a delicate meshwork of connective tissue fibers.



Fig. 4. Case 1, Path. No. 43,337. High power photomicrograph showing keratinization, irregularity of cells, and absence of mitotic figures. This tumor reacted well to external radiation and the patient is apparently well 5 years after treatment.

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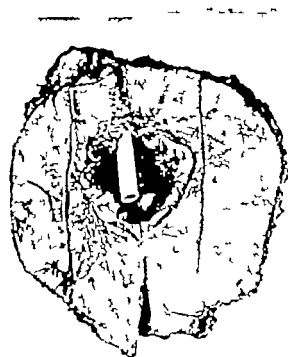


Fig. 2. Case 3. Path No. 37,670. Photograph of specimen removed from epithelioma of the anus. This tumor was of the ulcerating type and had completely destroyed the anal aperture. The pointer is in the continuation of the anal canal. A combined abdominoperineal resection was performed, a wide margin of normal tissue being removed. The patient is well 4 years later without sign of reappearance.

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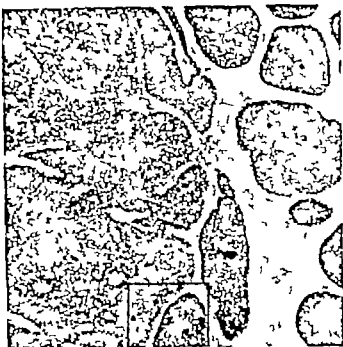


Fig. 7 Case 3 Path. No. 32,528. Low power photomicrograph of an epithelioma of the anus which was thought to have developed as a result of X ray burns. The cells grow in a discrete manner suggesting basal cell carcinoma, forming well marked lobules separated by a dense fibrous connective tissue.

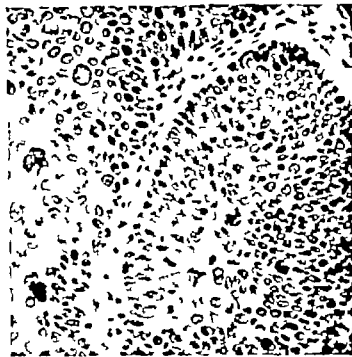


Fig. 8 Case 3, Path. No. 32,528. High power photomicrograph of tumor depicted in Figure 7. Eleven mitotic figures can be seen in this field, certainly indicating a growth of high malignancy. In spite of this the patient has remained alive for 7 years since this section was taken and shows no apparent sign of malignant growth at the present time. This was a confusing case since the only operative treatment was local excision of the skin nodules.

years she attributed the pain to that source. At the birth of her last child some months before she had received a third degree tear into the rectum resulting in partial incontinence of feces and urine. Examination revealed relaxation of the perineal musculature with a marked rectocele and cystocele. On the right side of the anus was found a firm ulcerated nodule with raised edges. This was 3 centimeters long and 1 centimeter wide and had infiltrated the soft tissues beneath. It bled easily to touch and superficially resembled an epithelioma. Biopsy was advised and performed.

Operation was done June 25 1930 (Biopsy Path. No. 43337). The pathologist reported squamous cell carcinoma from the section.

Postoperative course. Treatment of the epithelioma was considered more urgent than repair of the perineal tear. Accordingly since there were no available beds at the time, she was sent to another hospital. Here she received a course of X ray therapy but the dosage and number of treatments are not known. Two years later she again reported to this hospital for repair. On examination she was found to have no sign of the tumor. There was a small cicatrix at the former site of the lesion but no ulceration and little induration. The patient remained apparently well, 28 months.

The specimen received for examination consisted of a thin flattened piece of tissue 1 centimeter in diameter. One surface was smooth and grayish in color the other rough and hemorrhagic. The tissue was composed of a malignant hypertrophy of strati-

fied squamous cells growing in irregular whorls and strands. The central portions of some of these were necrotic. The cells varied tremendously in size and mitotic figures were seen in roughly 1 per cent of the nuclei. The cytoplasm was eosinophilic, and the cell borders were not clearly marked. The stroma was composed of loose fibrous tissue heavily infiltrated with leucocytes and small round cells (see Figs. 3 and 4).

Diagnosis squamous cell epithelioma of the diffuse type.

CASE 2 (Unit No. 71526) G F a white female, aged 61 years entered the hospital on May 15 1928 complaining of an ulcer in the anal region. Nine months before this she had undergone an operation at another hospital for the removal of three small indurated lumps. These had been diagnosed condylomata and the condition was regarded as benign. Following the operation there appeared a residual ulcer at the site of incision which failed to heal under conservative treatment. She had received at that time some radium but the exact dosage was not known. She had been warned against the possibility of cancer and came to this hospital for advice and treatment. Physical examination was negative except for the rectal findings. Along the posterior commissure of the anus there was a deep ulcer 5 by 8 centimeters in size. The proximal portion extended within the anus. The edges curled over a hard cartilaginous base which exuded a foul smelling sero-



Fig. 9. Case 8, Path. No. 7233. Low power photomicrograph of an epithelioma of the lower rectum. The cells grow in well circumscribed strands and groups separated by a fairly dense fibrous tissue. Its morphological structure is strikingly like that of basal cell carcinoma. The tumor recurred after excision and caused the death of the patient 3 months after operation.

purulent discharge. Rectal examination was impossible on account of the pain induced.

Operation was done June 16, 1928 and consisted of a combined abdominoperineal resection. An incision was made about the anus well beyond the margin of the ulcer. The incision was carried through skin and subcutaneous tissues and the rectum was dissected free together with a large wedge shaped piece of tissue including the sphincters. The dissection was carried as high as possible and the rectum divided the proximal stump being inverted and closed tightly. The perineal defect was then packed and the patient's position reversed on the table. Through an abdominal incision the rectal stump was drawn up and a permanent colostomy made.

The patient made an uneventful recovery. The wound healed by granulation and was almost entirely closed at the time of her discharge on July 4, 1928. She was seen at intervals of 3 to 4 months since that time and has shown no signs of recurrence. She has been well for 4 years.

The operative specimen consisted of a piece of skin 13 centimeters in diameter surrounding the anus and attached to 15 centimeters of normal rectum. On one side of the anus there was a large deep penetrating ulcer with a hard papilliform base. The cut sections showed extensions from this penetrating the tissues beneath. Attached to one portion of the specimen was a piece of vaginal wall which however did not appear to be invaded by the tumor (Figure 2).

The stained section (Path. No. 37679) showed a diffuse invasion of the tissues by irregular strands of epithelial cells. These were squamous in type, irregular in size and showed mitotic figures in about 1 per cent of the nuclei. There was no tendency toward pearl formation. Throughout the entire section there was a profuse infiltration of small round cells and leucocytes.

Diagnosis. Squamous cell carcinoma of the anus, diffuse type.

CASE 3. (Unit No. 63159.) On June 16, 1925, M. D., a white female of 39 years, first came to the clinic. The onset of her symptoms dated back to 1906 when she first noticed an intense itching in the perineal region and at the same time a small draining sinus to one side of the anus. The discomfort persisted intermittently until 1910 when an abscess formed at the site of the fistula. This was treated by a local physician but proved to be especially resistant to healing and remained as a chronic draining sinus. During the course of the next 10 years, she consulted many private physicians and hospitals seeking relief but was not permanently helped. In 1920 she received a course of X-ray treatments lasting over a period of 7 months although the number of treatments and dosage is unknown. Following this, the itching was relieved but it was found that she had developed X-ray burns over the anus, vulva, and the backs of the hands where she had exposed them while retracting the buttocks during treatment. She first visited this hospital 5 years later. At this time the complaints were return of the itching, pain, bloody discharge and lumps at the margin of the anus. Examination revealed a contracture of the anus with extensive scarring on either side. In the anterior right quadrant was found a tiny fistulous opening which barely admitted the tip of a probe. Bordering the anus, could be seen and felt several hard polypoid masses resembling fibrosed hemorrhoids. They were thought to be old hemorrhoidal tags and excision advised.

Operation was done June 16, 1925. The external hemorrhoids were excised. The pathologist reported malignant change in the excised tissue.

After hospitalization for a few days to recover from the effects of general anesthesia the patient was discharged with instructions to report to the out-patient department.

The patient returned July 1, 1925 for routine follow-up. It was found that the hemorrhoidectomy wound was healed but there was at the anal margin a small mass which had either recurred or escaped observation at the first operation. This was excised under local anesthesia.

A fistulous tract persisted at the time of her next visit on July 15, 1925. A biopsy of this tract again showed definite malignancy. In view of this wide excision was advised but was postponed because of the presence of infection, and treatment was directed toward cleaning up local infection.

She was next seen on August 14, 1925. Her general condition was improved but the presence of ca-

larged inguinal nodes was thought to indicate metastases and therefore inoperability. Nevertheless a gland excised for diagnosis was negative for cancer. The case by now presented a perplexing situation. If the pathological diagnosis had been correct it was difficult to understand the prolonged life of the patient when the fistulous tract had not been completely removed. In view of this no further operative procedure was attempted at the time.

On January 8 1926 at routine examination the anal condition was found to be entirely satisfactory but hypertrophic telangiectases had appeared over the vulva. In addition several scaly keratoses were found over the vulva and hands. These were regarded as results of the X ray burns.

For nearly 2 years thereafter the condition changed little if at all. The itching returned and she suffered from occasional lower abdominal cramps. When seen on January 3 1928 the lesions over the vulva had increased in size and were thought to be malignant. She was admitted to the hospital and on the following day the entire vulva was excised. The pathologist again reported malignancy on the basis of an X ray burn. The wound healed without complications and the patient was discharged improved.

No further symptoms were produced until March 31 1931 when the inguinal nodes again became enlarged. With the suspicion of metastases one was excised for diagnosis but as formerly showed nothing more than a chronic adenitis. The itching recurred a few months later and on examination a small ulcer was found in the left anterior quadrant. She was admitted for a third time and the ulcer excised. It was again reported transitional epithelioma. The wound failed to heal entirely and she was admitted a fourth time for wide excision. This time a biopsy showed nothing but inflammatory tissue. The wound healed nicely with proper care and the patient, still in good general health was discharged.

During the past year she has been seen on several occasions but there has been no recurrence of symptoms nor has the growth reappeared. On August 16 1931 a complete examination of the large bowel was made including a barium enema and sigmoidoscopic examination but no abnormality was found. At present her general health is good. The Wassermann reaction was negative on several occasions.

Result. She has been well 7 years.

There was nothing characteristic in the many small bits of tissue removed for diagnosis (Path. Nos. 46255 37164 32528 and 32597). Most of them were small pieces removed at biopsy. The specimen removed on January 5 1928 consisted of the entire vulva including the labia minora and the clitoris. These were hyperemic and edematous and near the posterior end of the right labia was seen a dehiscence ulceration 1 centimeter in diameter with rolled edges and an indurated base. Several bluish areas of telangiectases were scattered over the entire surface of both labia.

In general all of the specimens removed from the ulcerated areas showed the same type of epithelial



Fig 10. Case 8, Path. No. 17 233. High power photomicrograph of the tumor shown in Figure 9. This shows a fair uniformity of the size and shape of the cells and the presence of a few mitotic figures. Although this does not impress one as a tumor of high grade malignancy the patient died from reappearance of the growth after excision.

proliferation. There was a thickening of the epidermis with hyperplasia of the malpighian pegs which in some places had broken through the basement membrane and infiltrated the underlying tissues. It is possible that this might have occurred in a benign overgrowth of epithelium but in the presence of abundant mitotic figures (from 4 to 6 per cent of the nuclei) its malignancy could hardly be doubted. The cells grew in discrete groups and resembled in some ways a basal cell epithelioma. No pearls were found. Sections taken through the telangiectatic areas showed dilated and thrombosed vessels. It was thought that the growth on the vulva was a new lesion developing after an X ray burn and not an extension of the primary growth at the anus (see Figs. 7 and 8).

Diagnosis. Squamous cell epithelioma of the anus of the discrete type following X ray burns.¹

CASE 4 (Unit No 61010.) W O a colored male, aged 76 years was admitted to the hospital on September 29 1924, complaining of rectal bleeding for 2 months. Coincident with the onset of the bleeding he had noticed a small mass in the lower rectum which was sometimes palpable after a bowel movement. This was slightly tender and caused him moderate discomfort by obstruction to passing feces. On physical examination nothing could be seen externally. Examination of the rectum revealed

It is questionable if this tumor arose from the true anal epithelium or the skin of the perianum. In spite of its typical behavior the gross and microscopic characteristics were those of anal epitheliomata and the consensus of opinion favored the former origin.



Fig 9. Case 8, Path N. 17,333. Low power photomicrograph of an epithelioma of the lower rectum. The cells grow in well circumscribed strands and groups separated by a fairly dense fibrous tissue. Its morphological structure is strikingly like that of basal cell carcinoma. The tumor reappeared after excision and caused the death of the patient 1 month after operation.

purulent discharge. Rectal examination was impossible on account of the pain induced.

Operation was done June 16, 1928, and consisted of a combined abdominoperineal resection. An incision was made about the anus well beyond the margin of the ulcer. The incision was carried through skin and subcutaneous tissues and the rectum was dissected free together with a large wedge shaped piece of tissue including the sphincters. The dissection was carried as high as possible and the rectum divided the proximal stump being inverted and closed tightly. The perineal defect was then packed and the patient's position reversed on the table. Through an abdominal incision the rectal stump was drawn up and a permanent colostomy made.

The patient made an uneventful recovery. The wound healed by granulation and was almost entirely closed at the time of her discharge on July 4, 1928. She was seen at intervals of 3 to 4 months since that time and has shown no signs of recurrence. She has been well for 4 years.

The operative specimen consisted of a piece of skin 13 centimeters in diameter surrounding the anus and attached to 15 centimeters of normal rectum. On one side of the anus there was a large deep, penetrating ulcer with a hard papilliform base. The cut sections showed extensions from this penetrating the tissues beneath. Attached to one portion of the specimen was a piece of vaginal wall which, however, did not appear to be invaded by the tumor (Figure 2).

The stained section (Path. No. 37679) showed a diffuse invasion of the tissues by irregular strands of epithelial cells. These were squamous in type, irregular in size and showed mitotic figures in about 1 per cent of the nuclei. There was no tendency toward pearl formation. Throughout the entire section there was a profuse infiltration of small round cells and leucocytes.

Diagnosis. Squamous cell carcinoma of the anus, diffuse type.

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The stained section (Path. No. 37679) showed a diffuse invasion of the tissues by irregular strands of epithelial cells. These were squamous in type, irregular in size, and showed mitotic figures in about 1 per cent of the nuclei. There was no tendency toward pearl formation. Throughout the entire section there was a profuse infiltration of small round cells and leucocytes.

Diagnosis. Squamous cell carcinoma of the anus, diffuse type.

CASE 3. (Unit No. 63159) On June 16, 1925 M.D., a white female of 39 years, first came to the clinic. The onset of her symptoms dated back to 1900 when she first noticed an intense itching in the perineal region and at the same time, a small draining sinus on one side of the anus. The discomfort persisted intermittently until 1910 when an abscess formed at the site of the fistula. This was treated by a local physician but proved to be especially resistant to healing and remained as a chronic draining sinus. During the course of the next 10 years, she consulted many private physicians and hospitals seeking relief but was not permanently helped. In 1920, she received a course of X-ray treatments lasting over a period of 7 months although the number of treatments and dosage is unknown. Following this, the itching was relieved but it was found that she had developed X-ray burns over the anus, vulva, and the backs of the hands where she had exposed them while retracting the buttocks during treatment. She first visited this hospital 5 years later. At this time the complaints were return of the itching, pain, bloody discharge, and lumps at the margin of the anus. Examination revealed a contracture of the anus with extensive scarring on either side. In the anterior right quadrant was found a tiny fistulous opening which barely admitted the tip of a probe. Bordering the anus, could be seen and felt several hard polypoid masses resembling fibroid hemorrhoids. They were thought to be old hemorrhoidal tags and excision advised.

Operation was done June 16, 1925. The external hemorrhoids were excised. The pathologist reported malignant change in the excised tissue.

After hospitalization for a few days to recover from the effects of general anesthesia, the patient was discharged with instructions to report to the out-patient department.

The patient returned July 1, 1925 for routine follow-up. It was found that the hemorrhoidectomy wound was healed but there was at the anal margin a small mass which had either recurred or escaped observation at the first operation. This was excised under local anesthesia.

A fistulous tract persisted at the time of her next visit on July 15, 1925. A biopsy of this tract again showed definite malignancy. In view of this wide excision was advised but was postponed because of the presence of infection, and treatment was directed toward cleaning up local infection.

She was next seen on August 14, 1925. Her general condition was improved but the presence of ca-

larged inguinal nodes was thought to indicate metastases and therefore inoperability. Nevertheless a gland excised for diagnosis was negative for cancer. The case by now presented a perplexing situation. If the pathological diagnosis had been correct it was difficult to understand the prolonged life of the patient when the fistulous tract had not been completely removed. In view of this no further operative procedure was attempted at the time.

On January 8, 1926, at routine examination the anal condition was found to be entirely satisfactory but hypertrophic telangiectases had appeared over the vulva. In addition several scaly keratoses were found over the vulva and hands. These were regarded as results of the X-ray burns.

For nearly 2 years thereafter the condition changed little if at all. The itching returned and she suffered from occasional lower abdominal cramps. When seen on January 3, 1928, the lesions over the vulva had increased in size and were thought to be malignant. She was admitted to the hospital and on the following day the entire vulva was excised. The pathologist again reported malignancy on the basis of an X-ray burn. The wound healed without complications and the patient was discharged improved.

No further symptoms were produced until March 31, 1931, when the inguinal nodes again became enlarged. With the suspicion of metastases one was excised for diagnosis but as formerly, showed nothing more than a chronic adenitis. The itching recurred a few months later and on examination a small ulcer was found in the left anterior quadrant. She was admitted for a third time and the ulcer excised. It was again reported transitional epithelioma. The wound failed to heal entirely and she was admitted a fourth time for wide excision. This time a biopsy showed nothing but inflammatory tissue. The wound healed nicely with proper care and the patient, still in good general health was discharged.

During the past year she has been seen on several occasions but there has been no recurrence of symptoms nor has the growth reappeared. On August 16, 1931, a complete examination of the large bowel was made including a barium enema and sigmoidoscopic examination but no abnormality was found. At present her general health is good. The Wassermann reaction was negative on several occasions.

Result: She has been well 7 years.

There was nothing characteristic in the many small bits of tissue removed for diagnosis (Path. Nos. 46255, 37164, 32528, and 32507). Most of them were small pieces removed at biopsy. The specimen removed on January 5, 1928, consisted of the entire vulva including the labia minora and the clitoris. These were hyperemic and edematous and near the posterior end of the right labia was seen a definite ulceration 1 centimeter in diameter with rolled edges and an indurated base. Several bluish areas of telangiectasis were scattered over the entire surface of both labia.

In general all of the specimens removed from the ulcerated areas showed the same type of epithelial

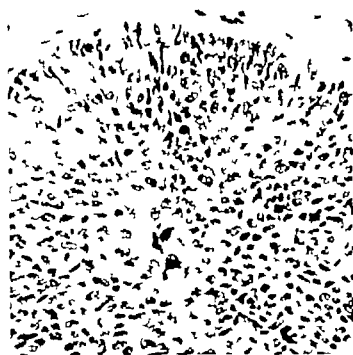


Fig. 10. Case 8. Path. No. 17,233. High power photomicrograph of the tumor shown in Figure 9. This shows a fair uniformity of the size and shape of the cells and the presence of a few mitotic figures. Although this does not impress one as a tumor of high grade malignancy the patient died from reappearance of the growth after excision.

proliferation. There was a thickening of the epidermis with hyperplasia of the malpighian pegs which in some places had broken through the basement membrane and infiltrated the underlying tissues. It is possible that this might have occurred in a benign overgrowth of epithelium but in the presence of abundant mitotic figures (from 4 to 6 per cent of the nuclei) its malignancy could hardly be doubted. The cells grew in discrete groups and resembled in some ways a basal cell epithelioma. No pearls were found. Sections taken through the telangiectatic areas showed dilated and thrombosed vessels. It was thought that the growth on the vulva was a new lesion developing after an X-ray burn and not an extension of the primary growth at the anus (see Figs. 7 and 8).

Diagnosis: Squamous cell epithelioma of the anus of the discrete type following X-ray burns.¹

CASE 4 (Unit No. 61010) W. O., a colored male aged 76 years, was admitted to the hospital on September 29, 1924, complaining of rectal bleeding for 2 months. Coincident with the onset of the bleeding he had noticed a small mass in the lower rectum which was sometimes palpable after a bowel movement. This was slightly tender and caused him moderate discomfort by obstruction to passing feces. On physical examination nothing could be seen externally. Examination of the rectum revealed

¹It is questionable if this tumor arose from the true anal epithelium or the skin of the perineum. In spite of its atypical behavior the gross and microscopic characteristics were those of anal epitheliomata and the consensus of opinion favored the former origin.

a hard mass on the anterior wall extending from the anal margin to the prostate. Over the center of this was a furrow into which could be laid the palpating finger. Induration at the lower end of the growth extended out under the skin for a distance of 2 or 3 centimeters, and could best be appreciated with one finger in the rectum and another exerting pressure on the perineum. Examination of the stools on one occasion showed the feces normal in consistency and color and negative for occult blood. The Wassermann reaction was negative.

Operation consisted in curettage of the sinus. In curetting the growth the mass was found to be firmly fixed and attached to the prostate. Considerable resistance was met with by the instrument giving the operator the impression of an extremely hard growth.

Following the operation 100 milligrams of radium in a rubber tube was inserted in the sinus, being held in place by a gauze pack. This was removed after 3 hours. The patient was discharged unimproved but returned to the out patient department for a series of X-ray treatments. During the following 7 months he received 25 treatments from a 200 kilovolt machine. The anode skin distance was 50 centimeters and the rays filtered through 0.5 millimeter copper and 2 millimeters of aluminum, the dosage consisting of 90 to 150 milliamperes minutes. The general condition of the patient improved as a result of this treatment but he did not become entirely symptom free. He continued to have pain and a persistent bloody mucous discharge. He was readmitted on June 3, 1923, for these symptoms. A small sinus at the anterior margin of the anus discharged a foul smelling seropurulent fluid. A palliative colostomy was considered but thought inadvisable. Accordingly the patient was discharged unimproved after 1 week of observation.

He was not followed.

The tissue received consisted of a few shreds removed at biopsy and were not characteristic in appearance (Path No. 31198).

The tumor was composed of pavement epithelial cells growing in a circumscribed manner forming nests and strands well delineated from one another. The cells were relatively small but varied a great deal in size and shape. Mitotic figures occurred in about 2 per cent of the nuclei. The stroma was scanty and most of the section was taken up by the actively growing cells. There was very little secondary infiltration.

Diagnosis: Squamous cell epithelioma of the discrete type.

CASE 5. (Unit No. 45128) L. H., a colored female 50 years of age was admitted to the hospital on January 5, 1920, complaining of a growth in the rectum and vagina. Her attention had been first called to it 1 year before and it had since then grown progressively larger. The mass caused a dull dragging pain in the lower pelvis which was somewhat relieved by hot applications and baths. Rectal hemorrhages had occurred every few weeks since

the onset of symptoms and during the last of these about a week before admission approximately a pint of blood had been lost. She felt that on occasions the pressure of the mass caused a moderate dysuria. Some weight had been lost during the latter 9 months of her illness but the exact amount was not known. Physical examination revealed a hard irregular mass extending from the anus to the posterior portion of the vulva which had begun to infiltrate the surrounding perineum. The left labia was moderately hypertrophied and indurated. The tumor mass had not extended into either the rectum or vagina. The Wassermann reaction was negative. The condition was diagnosed epithelioma of the anus and although no metastases were evident the size of the growth was regarded as indicative of inoperability. Nevertheless it was felt that a palliative excision would partly relieve her symptoms.

Operation was done March 1, 1920, and consisted in a palliative excision of an epithelioma of the anus. The excision was carried wide of the mass and included a part of the anal margin and sphincter. A rectal tube was inserted and the wound closed without drainage.

The wound broke down on the eighth day after operation but thereafter healed by granulation. The patient was discharged on March 24, 1920, improved but with partial loss of sphincter control. X-ray treatment was instituted and over a period of 3 years a total of 35 treatments were given with a voltage of 80 kilovolts, at an anode skin distance of 25 centimeters, in doses varying from 5 to 60 milliamperes minutes with 4 millimeters aluminum, 1 centimeter wood and 2 millimeters bakelite filters. This was efficient in relieving the patient of all pain and bleeding but the subsequent appearance of nodules in the vulva precluded a hopeful prognosis. About 3½ years after the operation, the patient again began to suffer from pain and dysuria. Thereafter her course was steadily downhill and she died on March 20, 1923, almost 3 years after her first admission to the hospital.

The specimen (Path. Nos. 23880 and 24072) consisted of a wedge shaped piece of tissue 10 by 5 by 2 centimeters, the outer surface of which was covered by skin. From this projected two nodular elevations, one of which seemed to be undergoing degeneration. These masses offered resistance to the knife when cut and exposed a grayish white tissue studded with yellow spots. The consistency was of cartilaginous density (see Fig. 1).

The tissue was composed of a malignant hypertrophy of squamous cells growing in discrete sheets and groups with a minimal stroma. These were large and irregular both in size and shape. Necrosis was marked in the centers of some of the cell groups, but there was no tendency toward pearl formation. Mitotic figures were found in less than 1 per cent of the nuclei (see Figs. 5 and 6).

Diagnosis: Squamous cell epithelioma of the discrete type.

CASE 6 (Unit No 38830) I M., a white female of 41 years entered the hospital on August 1, 1918, complaining of pain in the rectum. Ten weeks before a swelling had appeared on the right side of the anus which was thought by her local physician to be an abscess, and opened. This healed but the swelling returned and with it pain appeared. She could not sit without a great deal of discomfort and defecation caused her extreme pain. She had attributed occasional dysuria to the presence of the mass. Physical examination showed a mass on the right side of the anus dissecting into the perineum and out beneath the skin of the buttocks, making rectal examination extremely painful. The mass was red and tender and extended from the rectum to the vagina. It appeared grossly to be an abscess and at one point there was a small fistula from which pus was escaping. A cursory rectal examination revealed some swelling and induration inside the rectum. Malignancy was suspected and biopsy advised. In view of the pain on defecation it was thought advisable to perform a palliative colostomy.

Operation was done August 3, 1918 and consisted in colostomy and excision of perineal sinus with division of the sphincter. The pathological report showed malignancy in the section and the case was regarded as inoperable.

Postoperative treatment consisted in the application of 100 milligrams of radium in a rubber tube inserted in the operative wound but this fell out after 3 hours and was not replaced. She was discharged 3 weeks after the operation somewhat improved. The colostomy was working well and the symptoms were relieved. The patient was seen once 2 months later by a visiting nurse who reported progress of the malignant condition. Due to lack of co-operation by the family subsequent visits were unfruitful and the case was dropped.

The specimen (Path. No 21641) received in the laboratory consisted of two small pieces of tissue, each about a centimeter in diameter, evidently comprising a portion of the sinus tract.

The section was composed largely of fibrous tissue bordered by epithellum on one side. Throughout the abundant stroma could be seen a diffuse proliferation of epithelial cells varying tremendously in size and shape. These grew in an irregular manner and preserved no distinct line of demarcation from the surrounding tissue. A few pearls were seen and other evidence of early keratinization. Mitotic figures were present in less than 1 per cent of the nuclei.

Diagnosis Squamous cell epithelioma of the diffuse type.

CASE 7 (Unit No 20962) J M., a white male aged 45 years was admitted to the hospital on July 6 1915 complaining of pain in the perineum. The onset of symptoms 8 weeks before was marked by the appearance of a small abscess just outside the anal margin which ruptured spontaneously and healed in about a week's time. Following this the patient began to suffer from a dull dragging pain in

the lower pelvis which change of posture would not relieve. This became severe enough to keep him awake at night. Frequency of defecation and tenesmus were associated with the pain. Physical examination showed an elderly white man who was made irritable by the constant presence of pain. Nothing could be seen or felt on external examination of the anus but on digital examination of the rectum a firm hard ridge could be felt beginning just within the anus on the anterior wall and extending upward to the prostate and the retrovesical pouch. The Wassermann reaction was negative. The condition was thought to be malignant and resection was advised.

Operation was done July 10, 1915. Through a preliminary colostomy, a brief exploratory examination revealed no metastases.

On July 10, 1915 a partial resection of rectum was done. The coccyx was removed through a sacral incision and the rectum was dissected free for a distance of 3 inches above the sphincters. At this point the condition of the patient became so bad that the tumor was separated from the prostate rapidly, leaving the operator uncertain as to whether he had removed the growth *in toto*. The wound was closed and the patient left the table in poor condition.

The patient was in a severe state of shock following the operation from which he did not recover and succumbed 3 days later to myocardial failure.

The tissue (Path. No 17319) removed at operation consisted of a portion of the rectum with the anus. When this was opened there was seen on the anterior surface an elongated tumor mass which had indurated but had apparently not extended beyond the wall of the bowel. This was firm and when cut exhibited a dense fibrous consistency. The upper end of the tumor had been cut across during its removal so that it was evidently only partly removed.

The tumor was made up of groups of cells growing in a circumscribed manner in a scant but dense stroma. They were relatively small but variable in size. No pearls were seen and mitotic figures occurred in less than 1 per cent of the nuclei. The cells were apparently of epidermal origin and grew in a manner suggesting basal cell carcinoma.

Diagnosis Squamous cell epithelioma of the anus, discrete type.

CASE 8 (Unit No 23195) E. M. a white female aged 43 years, was admitted to the hospital on March 22 1915, complaining of hemorrhoids and occasional bleeding from the rectum, over a period of 5 weeks. Pain was a prominent factor and was accentuated by bowel movement or by sitting down. It was increased by constipation and relieved by diarrhea. Her appetite was poor and she had lost a moderate amount of weight. Physical examination showed a well nourished woman without appreciable signs of malaise. The abdominal findings were negative except for a moderate amount of right lower quadrant tenderness. Rectal examination revealed an obstruction in the form of an annular stricture just above the sphincter above which could be felt

several small polypoid growths. The condition suggested malignancy and a biopsy was performed.

Operation was done March 24, 1915 and consisted in dilation of stricture and biopsy of growth. The pathologist reported a malignant tumor of the squamous cell type.

A radical operation was advised but was refused by the patient. Accordingly she was discharged and referred to a convalescent home. She returned to the hospital 3 months later with symptoms practically unchanged having decided to submit to the operation. The symptoms and signs had changed very little in the interval.

A preliminary colostomy was done June 2, 1915.

On June 23, 1915, perineal proctectomy was performed. After making a linear sacral incision the operator first removed the coccyx then dissected the rectum free 6 inches above the tumor where it was divided. The anus was then divided with a narrow margin of skin and the tumor was removed intact. The wound was packed and allowed to heal by granulation.

The perineal wound closed slowly and the patient was discharged on September 13, 1915 with the colostomy working satisfactorily. For over a year the patient lived and was symptom free. About 14 months after the operation however symptoms recurred and from then on the course of the disease was steadily downward. She died 31 months after the operation from a reappearance of the tumor.

The specimen (Path. Nos. 17333 and 16877) removed at operation consisted of the rectum and the anus. At the anal margin were several hemorrhoids. On the posterior wall of the lower rectum about 2 centimeters above the sphincters was seen a hard indurated projection into the lumen of the bowel. This extended about half way around the gut but did not entirely obstruct it. Ulceration was starting in one place. Several enlarged glands were found in the perirectal tissues posterior to the tumor. On cutting through the mass it was found to be hard and glistening. White strands extended through all coats of the rectal wall. The lymph glands were yellowish white in color and contained minute white cystic spaces.

The tumor was composed of malignant squamous cells densely packed together in a cellular fibrous stroma. They formed discrete groups which were well circumscribed. The cells were large and the nuclei varied in size from 6 to 12 microns in diameter. Mitotic figures were found in less than 1 per cent of the nuclei, and although no pearls were seen, the cells were relatively well differentiated. Occasional giant cells were found some of which contained two or more nuclei. The sections taken from the lymph glands showed the normal structure almost entirely replaced by cells of the same type as found in the original tumor (see Figs. 9 and 10).

Diagnosis. Squamous cell epithelioma of the lower rectum, discrete type.

CASE 9. (Unit No. 20584.) L. M., a white female 42 years of age, entered the hospital on January 25,

1915 complaining of rectal bleeding for 3 months. This was preceded several months by weakness, dyspnea, and headaches which she felt were not related to the melena. The bleeding was intermittent at intervals of from one to several days and on a few occasions was copious. Weakness had increased during the month previous to admission. Examination showed the abdomen slightly distended and tender to palpation throughout. At the anal margin were seen several hemorrhoids and 3 centimeters above the sphincter was felt a narrowing of the lumen similar to a muscular contraction. The hemoglobin was 40 per cent. Proctoscopic and sigmoidoscopic examinations were negative. The case was diagnosed hemorrhoids and excision advised.

On January 27, 1915 the external hemorrhoids were excised. Two large polypoid masses were clamped and excised with a cautery. During this process a depression was seen just within the sphincter which was covered by dark tissue and contained a small ulceration at the base. A piece of this was excised for diagnosis.

The patient was discharged 3 days later. The pathological report which was received after discharge was carcinoma. It was impossible to get in touch with the patient and the case was dropped. She returned 3 months later with an exacerbation of symptoms. In addition she was suffering from lower abdominal pain. There was no evidence of any extension of the ulcer noted on previous examination. Exploratory laparotomy was thought feasible.

Operation was done March 1, 1915 an exploratory laparotomy. The findings were entirely negative and nothing was found to account for the symptoms. The bleeding was attributed to internal hemorrhoids.

The patient recovered without complications and was discharged improved symptomatically. Blood was seen in the stools only twice during convalescence. Following discharge the patient failed to report for follow up and the ultimate result is not known.

The material (Path. No. 16653) received from the biopsy consisted of a few small shreds of tissues. There was nothing characteristic in the gross appearance.

The tissue was made up of homogeneous groups of squamous epithelial cells grouped about central degenerating areas. The cells were small, varying from 4 to 9 microns in diameter. Mitoses occurred in less than 1 per cent of the nuclei but the cells appeared to be definitely malignant. The stroma was scanty but infiltrated by many leucocytes.

Diagnosis. Squamous cell epithelioma of the anus, diffuse type.

CASE 10. (Unit No. 5893.) A. P., a white female aged 48 years, was admitted to the hospital complaining of rectal bleeding. She had noticed blood in the stools on one occasion 15 years before but it did not recur until 1 year before admission. At that time she had a moderately severe hemorrhage accompanied by a sensation of something giving way. At first the bleeding was intermittent every few

TABLE I.—SUMMARY OF DATA ON TEN EPITHELIOMATA OF THE LOWER RECTUM AND ANUS

| Case | Location | Gross type | Microscopic type | Treatment | Result |
|------|--------------|-------------------------------------|------------------|-------------------------------|--|
| 1 | Anus | Ulcerative | Diffuse | X Ray | Living 2 yrs. |
| 2 | Anus | Ulcerative | Diffuse | Abdominoperineal resection | Living 4 yrs. |
| 3 | Anus | Nodular | Discrete | Local excision | Living 7 yrs. |
| 4 | Lower rectum | Nodular | Discrete | X-ray and radium | Not followed |
| 5 | Anus | Nodular | Diffuse | Palliative excision and X ray | Dead, 26 months from reappearance of tumor |
| 6 | Anus | Ulcerative | Diffuse | Palliative colostomy radium | Not followed |
| 7 | Lower rectum | Nodular | Discrete | Perineal excision | Dead from postoperative shock |
| 8 | Lower rectum | Nodular (with secondary ulceration) | Discrete | Perineal excision | Dead, 21 months from reappearance of tumor |
| 9 | Anus | Ulcerative | Diffuse | None | Not followed |
| 10 | Lower rectum | Ulcerative | Diffuse | Perineal excision | Dead from postoperative shock |

weeks but during the last 5 months of her illness some blood appeared with almost every stool. For 4 months she had suffered from a constant dull pain in the rectum which was worse when she sat or lay down and was relieved by walking or moving about. Weakness and fatigability contributed to the condition and she had lost a moderate amount of weight. On examination a small protrusion was seen at the anal margin which resembled a hemorrhoidal tag. Digital examination of the rectum showed a collar shaped growth beginning at the mucocutaneous border and extending upward about 4 centimeters. The surface was rough and bled easily to touch. It was freely movable, and there was no evidence of extension. The condition was diagnosed carcinoma of the rectum and radical extirpation was advised.

On April 29, 1908, perineal resection of the rectum was done. Through a linear incision from the anus to the sacrum the coccyx was removed and the rectum dissected free. A circular incision was then made about the anus and the bowel freed to a point 1 inch above the tumor. The bowel was divided at this point and the lower end brought down and sutured to the skin edge.

The patient was in poor condition when she left the operating room. She went into shock from which she never recovered and died on the following day.

The specimen (Path. No. 8252) removed at operation consisted of the lower rectum and anus. Just inside the anal orifice was found an annular tumor 5 centimeters in length. The surface was ulcerated and the consistency was hard and fibrous.

The section showed large masses of epithelial cells infiltrating the entire rectal wall in poorly defined groups. In some places the cells were stratified, in others cuboidal, but throughout there was marked irregularity in both size and shape. Mitotic figures were found in about 2 per cent of the nuclei. The stroma was scanty and loaded with leucocytes. The

tumor cells were poorly differentiated and indicated a tumor of relatively high grade malignancy.

Diagnosis Squamous cell epithelioma of the lower rectum diffuse type.

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DETAILED STUDIES OF A SERIES OF GALL-BLADDER CASES¹

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IN a series of previous communications the results of experimental studies on the gall bladder were reported which may be summarized somewhat as follows: (a) Infection may easily reach the gall bladder from the rich flora of the adjacent liver (4) which acts as a filter for the many bacteria entering the body through the gastro-intestinal tract (10). (b) Cholesterol precipitation is brought about by the absorption of its solvent the bile acids, by the diseased gall bladder (1: 9). In our use of the term "diseased gall bladder" the vagueness was intentional and it was emphasized that thus far the various factors of disease i.e. infection, oedema, stasis, irritation from extraneous material, etc. could not be separated. (c) The normal gall bladder in its process of concentrating the bile, does not absorb bile acids any faster than cholesterol, if at all and hence causes no tendency to stone formation. (d) Cholesterol is not excreted by the gall bladder mucosa in sufficient quantities to be a factor in stone formation (2). (e) Calcium is rapidly absorbed from the acutely infected gall bladder (5). (f) In spite of large numbers of experiments it could not be shown that the character of the bile secreted by the liver was of importance in the problem and the blame seemed to attach to the gall bladder (7: 13).

In the meantime the importance of cystic duct obstruction in the deposition of calcium in the bile or on stones was noted by Phemister (24) and has since been produced experimentally both by him (25) and by ourselves (2).

With these points in view pathological and bacteriological chemical studies were made of a series of 61 operative gall bladder cases. Although in many cases the studies were for obvious reasons incomplete as can be seen from the table the goal aimed at was to do in each case all the analyses which might throw light on the subject, and enough data have been gathered in most cases to be of value. In many of the multitudinous studies previously reported only one or two of the single fac-

tors have been investigated the accumulation of much data on even this short series therefore throws new light on the subject.

PROTOCOLS

A definite technique was aimed at in acquiring the specimens. Where possible, liver bile was secured from the common duct for study. It was attempted to clamp the cystic duct as soon as possible in the course of the operation so as to prevent escape of bile from the gall bladder and thus to get figures on the total gall bladder contents. Another clamp was placed across the tip of the fundus to serve as a handle and the specimen was immediately delivered to the laboratory without the clamps being removed. A special attempt was made to avoid handling the gall bladder during the operation so as to avoid bleeding into it and also breaking off of the delicate villi.

The closed gall bladder was then aspirated with a fine needle to get sufficient material for culture and for hydrogen ion determination. It was then X-rayed aseptic precautions still being used in handling the specimen. The tip with the clamp was then cut off and divided into two portions, one for culture and the other for chemical analysis. The bladder with the clamp on the cystic duct was then placed in a bottle and filled with formalin through the hole in the fundus and after being distended thus for a few minutes, was immersed in the fixative. After hardening it was cut into rings 1 centimeter thick, and each ring was embedded in paraffin and cut. The larger ones were embedded in celloidin. It was in this manner possible to get serial sections about 1 centimeter apart from the duct to the fundus.

The bile was then centrifuged and the sediment, if any analyzed separately. In some cases there was not sufficient bile to permit this. The analyses were made as follows. The white blood count was done by the usual method except that 1 per cent acetic acid was neces-

¹Read before the Western Surgical Association, December 15, 1911.

sary to neutralize the alkaline bile. The bile acids were estimated according to the method of Schmidt and Dart, Koch's modification of the amino nitrogen apparatus of Van Slyke being used. Cholesterol was estimated by the method known as Bloor (11). The extraction and separation of these substances from the bile was done with petrol ether as described by us (6). It permits both analyses on 1 cubic centimeter of bile, a valuable point as many diseased gall bladders have a small bile content. Calcium estimations by the usual blood technique are not interfered with by the bile pigment which is all removed by the strong acid. The Clark Collip modification of the Kramer and Tisdall method was used. Hydrogen ion estimations were done by the Hastings method and the carbon dioxide by that of Van Slyke.

In the tissue analyses the bit was weighed wet and then dried and weighed again, *in vacuo* at room temperature over calcium chloride. The tissue was then ground and extracted with alcohol and ether and the cholesterol estimation made as above. For calcium, after the wet and dry weights were obtained, the tissue was oxidized and run as above. In both cases the analyses are expressed in terms of dried tissue, as this tends to rule out the factor of oedema. In a few cases the cholesterol content was estimated on preserved specimens and the results seemed to be within the same range as did the fresh specimens. Cholesterol is of course absolutely insoluble in water or formalin. On the other hand, calcium is rather soluble in acid media, so fresh specimens cannot be used.

In many cases duplicate or even triplicate estimations were done to insure the accuracy of the work. This was especially true in the difficult gas analyses where frequent checking was necessary. We are thus able to give the following estimate of the accuracy of our work which may prove of value in evaluating it. Bile acids expressed in terms of glycocholic, exceedingly delicate, error less than 2 per cent. Bile cholesterol, very crude, margin of error about 20 per cent, tissue cholesterol, the same, with a tendency for the figures to run too low on account of incomplete extraction. In the case of the tissue calcium as well as blood cal-

cium, variations of 0.2 milligrams per 100 cubic centimeters can be demonstrated.

The bacteriological examinations were planned to give a quantitative as well as qualitative result. The gall bladder wall was implanted into Rosenow's bran broth, the lower portions of which acted as anaerobic media. The bile was planted into the same media and as well various dilutions of 0.1 cubic centimeter were inoculated into poured plates in order to make bacterial counts. If more than one organism was encountered in the smears, plates were poured and pure cultures secured and identified by suitable means.

ANALYSIS OF RESULTS

Grouping cases into definite types has been a matter of great difficulty on account of the lack of correlation between the criteria usually used. The total lack of any apparent relation between the cultures, the pathological findings, and the clinical histories, has in many cases been very striking. Especially confusing is the fact that the gross findings at operation so frequently fail to fit in with the microscopic picture. In addition the finding of sterile bile and gall bladder wall in many clinically acute cases gives food for thought. Only the most elementary classification into types has therefore been possible, and even this requires explanation.

1. *The normal gall bladder* (Table I). This group includes cases with normal or nearly normal gross and histological findings with no stones, 6 cases. Three patients had had typical afebrile colics, one with jaundice. All were operated upon during intervals. The absence of findings together with the fact that all 3 were relieved of their colics makes it probable that all had passed their stones. One patient was a diabetic with beginning cirrhosis of the liver and a few mild attacks. At the request of Dr. Russel Wilder a cholecystectomy and drainage of bile was done. Another was operated upon with a history of mild afebrile colics, which, though hardly sufficient to warrant operation *per se*, corresponded with a severe flare up of arthritis deformans. The sixth had had quite severe acute attacks with fever. Non-visualization with intravenous dye had previously been noted. She was operated

TABLE I

| Case No. | Type | Last colic | Last fever | Last jaundice | X-ray | Operation | Gross pathology | | | Specimens | Calcoli |
|----------|---|------------|------------|---------------|---------------------------|------------------------------------|-----------------|--------|--------------------------------|-----------|--------------------------------|
| | | | | | | | Cystic | Common | Gall bladder | | |
| | | | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 44551 | Biliary colic, m. age, fever | 3 days | month | month | — | E | P | P | Edema | N-1 | |
| 44779 | Mild biliary colic | Weeks | | | — | E | P | P | Normal Bile duct gastric ulcer | N | |
| 44963 | Diabetes, chills, m. colic | Weeks | | | NV | E with drainage of common | P | P | Thick, adherent | | |
| 44978 | Mild biliary colic | 3 days | | | NV | E | P | P | Thin | N | |
| 47700 | Old history repeated colic | Old | | | NV | E | P | P | Slightly thick glands | N | |
| 48048 | Very mild colic, removal of choleliths | Slight | | | NV | E | P | P | Normal | N | |
| 49082 | Previous G.B. drainage, recurrent pain | | | | NV large Ca | E | P | P | Normal except adhesions | N | 3 chol. Ca in cholel. |
| 49739 | Mild severe colic, Pyloric obstruction? | Weeks | | | — | E | P | P | Normal | N | Hundreds of small chol. stones |
| 49894 | Duodenal ulcer and few colics | Old | | | Flat x-ray | E | P | P | Normal | N | no |
| 49898 | Cystic duct obstruction. Repeated atypical colics | Recent | | | Flat x-ray | E | P | P | Normal | N | At chol. few traces Ca |
| 49898 | Nonrecurrent typical colics | Old | | | Flat plate large Ca stone | E | P | P | — | N | 4 |
| 49940 | no years colic now jaundiced | Few days | ? | + | — | E | P | P | Adhesions distended | N | |
| 49941 | Silent jaundice | | | ++++ | — | Cholecystectomy | P | C | Tissue distended, no pancreas | | |
| 49942 | Silent jaundice | | | + | Neg. G.L. | Cholecystectomy | P | C | Tissue distended, no pancreas | | |
| 49943 | Flaccid, P.M. respiratory, partial paralytic | Active | + | + | Flat plate neg | Cholecystectomy | P | ? | — | | homogeneous chol. |
| 49944 | Cholecystitis, initial fever | Active | + | + | Flat plate neg | E with stone in common and hepatic | C | C | Thick adherent | | no chol. |

Column 5 NV, normal visualization.
Column 7 P, present, C, closed

upon in an interval and the absence of any pathological findings was a surprise. Unfortunately no follow-up report is available on this patient. While it cannot be said that these patients were normal as the five followed were cured, the total absence of operative findings justifies the statement that they were at least quiescent at the time of operation.

2. *A normal gall bladder with stones* (Table I) This group is self-explanatory. It includes 5 cases. Two were in all likelihood silent stones as the symptoms could easily be explained by

other causes, one duodenal ulcer and one colitis. The 3 others were quiescent at the time operation was done as they had had typical biliary colics. In all 5 the gall bladder was thin walled, the cystic duct patent and the stones of the multiple faceted cholesterol type, 3 having slight calcium rings about them.

3. *Jaundice* (Table I) In this group are placed 5 cases with common duct obstruction but with the cystic duct patent. In those jaundiced patients with the cystic duct closed, it was obvious that the jaundice was not an

TABLE I

| Bile | | | | | | | | | | Sediment | | Total in G.B. | | G.B. Wall | | Cultures | | P.O. Reaction |
|--------|--------|------|-------|----------|------|-----------------|------|--------|----|----------|------|---------------|-----|----------------------|--------------------------|-------------------|-------------------|---------------|
| c. cm. | W.B.C. | R.S. | Chol. | BS/Chol. | Ca | CO ₂ | pH | Chol. | Ca | Chol. | Ca | Chol. | Ca | Chol. | Ca | Wall | Bile | |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 12 | | 1375 | 33 | 69 | | | | | | 4.93 | | | | | | S | S | |
| 11 | 1823 | 2300 | 216 | 20 | 46.3 | 20 | 6.84 | 0 | | 25.96 | 3.09 | | | | | S | S | 0 |
| | | 1130 | 69 | 16 | 21 | | | 0 | | 2.76 | 84 | | | | | Staph. albes | S | 0 |
| 14 | 1000 | 1450 | 143 | 38 | 30.1 | 26.3 | 7.1 | 005 | | 20 | 4 | 1060 | 280 | B. weicki | B. weicki 1-3 per c. cm. | | | 0 |
| 1 | 2000 | 2473 | 167 | 21 | | 26 | 6.9 | | | 16 | | 960 | 170 | S | S | | | 0 |
| 8 | | 1373 | 300 | 8 | 15 | 40.3 | | | | 54 | 6.3 | 200 | 140 | B. weicki | S | | | 0 |
| 1 | | 2624 | 230 | 12 | | | | | | | | | | | | B. weicki | S | 0 |
| | | 175 | 78 | 2 | 3.7 | | | | | | | | | | | | | 0 |
| 5 | 3.1 | 870 | 80 | 10 | | | | | | 2.2 | | 330 | 16 | B. coli staph | B. coli, staph 150 | | | 0 |
| 7 | 346 | 2695 | 95 | 28 | 20 | | | 46 | | 8 | 14 | 850 | 820 | Gram and diptheroids | Gram and diptheroids 200 | | | 0 |
| 4 | 4000 | 1823 | 183 | 1 | 17 | 26 | 7.07 | 63 | | 74 | 6.8 | 138 | 30 | S | S | | | 0 |
| 18 | 1133 | 608 | 228 | 0 | 29 | 30 | 6.82 | 006 | | 6.8 | 2.9 | | | | | Few staph. | S | 0 |
| | | 1904 | 200 | 10 | | | | | | | | | | | | | | 0 |
| 15 | | 2940 | 63 | 43 | | | | | | | | | | | | | | Died |
| 17 | 1936 | 231 | 75 | 11 | 23.9 | | | .00006 | | | | | | | | | B. coli | Died |
| | | | | | | | | | | | | | | | | B. coli B. weicki | B. coli B. weicki | Died sepsis |

Column 12. c. cm. of bile. Exact in closed ducts. If duct open, some often escaped during operation.

Column 13. Figures show number per c. cm. of concentrated bile.

Column 14, 15. Figures in mg. per 100 c. cm.

Column 16. Vol. per cent.

Column 20, 21. Total content in mg.

Column 22, 23. Total in mg. exclusive of stones.

Column 24, 25. Mg. per 100 gm. dry wt.

Column 26, 27. S, sterile.

appreciable factor in determining the gall bladder contents and therefore they are placed in the acute group. These 5 included 2 carcinoma of the pancreas in which the gall bladder was anastomosed to the stomach or bowel, 1 case of suppurative portal thrombophlebitis, 1 of common duct stones, and 1 in which the cause of the obstruction could not be ascertained, but was probably a stone passed just

prior to the operation as the patient was cured after cholecystectomy.

4. *Acute cases* (Table II). This group includes all those showing signs of activity at or immediately before the operation. This activity was evidenced by pain, with or without jaundice, fever, or leucocytosis or the finding of fresh fibrinous exudate or typical pathological pictures of acute inflammatory process.

TABLE II—ACUTE

| Case No. | Type | Last colic | Last fever | Last tenderness | X-ray | Operation | Gross pathology | | | Sections | Calculus |
|----------|---|------------|------------|-----------------|-------------------------------|-------------------------------------|-----------------|------------|---|----------|---|
| | | | | | | | Cyst | Common | Gall bladder | | |
| 30413 | Ca pancreas | | 3 | 4 | 3 | 4 | 7 | 8 | 9 | 10 | 11 |
| 30413 | Ca pancreas | | ? | ++++ | Flat plate neg | Cholecyst gastrostomy | C partly | C | G.B. distended | | |
| 31240 | Active acute colic | 3 days | 4 days | Old | Flat plate neg | E | C | P | Thick, trans ligaments | | chol. |
| 33337 | Epist. colica. Juncoidal | day | | ++++ | Flat plate neg | E | C | Not scored | Normal | 3 | |
| 33365 | Entered in severe colic, operation 3 days later | days | + | + | Non vis | E | C | P | Very small thick fibrous | 3 | 3 chol. ca rim (chol) |
| 33561 | Active severe colic | days | | | NV | E | C | P | Adhesions scattered, some perforations | 3 | no pigment chol |
| 30414 | Many colics, marked indigestion | Few days | | | Non vis. Ca stones | E | P | P | — | | |
| 37307 | Almost constant R.U.Q. pain, indigestion | Recent | | | Non vis | E | C | P | Distended, thickened | 3 | 4 chol pigment |
| 33303 | Episodic acute severe colic attacks | 3 days | 3 days | ? | | E | C | P | Very thick, white, trans | 3 | 3 mixed chol. Ca pigment No rings |
| 31348 | Several typical colics | Old | | | Flat plate neg | E | P | P | Large thick | | pigmented chol. |
| 33073 | Emergency lap. case operation 1 case | Acute | + | | Flat plate neg | E | P | P | Excessive thick white fibrous | 3 | 17 chol. few ca rings |
| 33364 | Many typical colics | Few days | | | NV many chol stones | E | P | P | Normal adhesions | N-4 | 23 chol |
| 33337 | Frequent severe colics | 8 day | | | Large chol stones, ca rim, NV | E | Distended | Large | Thick, adherent | 3 | large chol. Ca rings throughout, ca rim pale opposite surface |
| 33369 | 3 colics, much indigestion | Acute | | | NV large chol stones | E | P? | P | Normal | | mixed, ca rings throughout, slight ca rim |
| 33374 | Uter. & adn. very tender G.B. colic | Recent | | | Non Vis Ca stones | E | C | P | Thick | | Many large fecal chol. with ca rim |
| 30414 | severe colic attacks | 3 day | days | ? | | E | C | P | Excessive white fibrous thick | 3 | epi chol |
| 30180 | Repeated colic attacks | days | + | | Non vis | R Drainage of common through cystic | C | P | Very thick, trans adhesions white | 3 | 73-80 chol. with some ca rim |
| 30733 | acute attacks Chronic | 5 days | days | day | Non vis | E | P? | P | Small thick | 3 | 43 chol |
| 37834 | Severe colic. B.O.B. very tender | weeks | ? | weeks | Non vis ca signs | P | C | P | Thick adn. fibrous | 3 | 17 mixed ca |
| 30793 | Many colics Entered acute stage | day | | | | E | P | P | Moderately thick distended | | 3 chol. Slight ca rings |
| 33330 | Many severe colics Entered acute, remained tender | 3 days | | | NV many chol stones | E | P | P | Slightly thick and few recent adhesions | | 611 chol |

See Footnotes for Table I.

TABLE II—ACUTE

| Bile | | | | | | | | | Sediment | | Total in G.B. | | G.B. Wall | | Cultures | | P.O. Reaction | | | |
|--------|--------|------|-------------------|----------|----|-----------------|----|-------|----------|-------|---------------|-------|-----------|------|----------|----------------------|---------------------|----------------|---|----|
| C.C.N. | W.B.C. | R.R. | Chol. | BS/Chol. | Ca | CO ₂ | pH | Chol. | Ca | Chol. | Ca | Chol. | Ca | Wall | Bile | | | | | |
| 2 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | | | | |
| 3 | | 273 | 1 | 300 | 2 | | | | | | | | | | | 0 | | | | |
| 1 | 6600 | 72 | 2 | 1 | 0 | 13 | 5 | 6 | 84 | 753 | 1 | 1 | 360 | 45 | B. coli | B. coli 3,000,000 | 0 | | | |
| 6 | | 0 | 31 | 2 | 0 | | | | | | 1 | 85 | | | | 0 | | | | |
| 5 | 4150 | 0 | 68 | 0 | 00 | 17 | 3 | 6 | 0 | 013 | 002 | 2 | 64 | 4 | 5 | 0 | 105 | Staph. B. coli | Staph. dipht. eroids, B. coli innumerable | 0 |
| 10 | | 0 | 15 | 0 | 12 | 20 | 4 | 8 | | | | 3 | 00 | | | | | Staph. A | Staph. A | 0 |
| | | | | | | | | | | | | | | | 5 | 5 | | | | 0 |
| 2 | 3240 | 610 | 6 | 300 | | 11 | 3 | | | | | 7 | | 1410 | 640 | 5 | 5 | | | 0 |
| 4 | 1 | 50 | 154 | 105 | 5 | 10 | 8 | | | | | 10 | 25 | 1300 | 720 | 5 | 5 | | | 0 |
| 3 | 875 | 0 | 83 | 0 | 7 | 32 | 7 | 24 | | | | 12 | 0 | 220 | 110 | B. weichi | B. weichi 25 | | | 0 |
| 37 | 1046 | 450 | 9 | 30 | 13 | 7 | 77 | 1 | 7 | 61 | | 14 | 67 | 2 | 22 | | 5 | Staph. A 100 | | 0 |
| 2 | 1250 | 1300 | 284 | 4 | 20 | 8 | | 0 | 0 | 8 | 6 | 6 | 32 | | | 5 | 5 | | | 51 |
| | | 642 | 38 | 16 | | | | | | | | 4 | 27 | | | 5 | 5 | | | 0 |
| 7 | | 45 | 360 | 12 | | | | | | | | 25 | 2 | | | 5 | 2 | | | 0 |
| 8 | | 272 | 132 | 2 | 15 | 5 | | | | | | 11 | 04 | 1 | 24 | | 5 | 5 | | |
| 75 | 17000 | 0 | Slight trace | 0 | 10 | 7 | 28 | 7 | | 60 | 2 | 4 | | 372 | 110 | B. coli | B. coli innumerable | ++ | abscess | |
| 1 | 1760 | 270 | 300 with crystals | 6 | | | | | | | | 75 | | 252 | 130 | Strep. | Strep. | | | 0 |
| 0 | 5 | 0 | + Qual | 0 | | | | | | | | | | 2100 | 100 | Staph. A | Staph. A | | | 0 |
| 10 | | | | | | | | | | | | | | | | B. coli +++ | B. coli | | | 0 |
| 0 | 4400 | 2605 | 120 | 17 | 30 | 20 | | 2 | 5 | | | 61 | 5 | 12 | 406 | 240 | 5 | 5 | | 0 |
| 13 | 4212 | 1871 | 102 | 28 | 30 | 1 | 20 | 0 | 6 | 00 | 27 | | | 86 | 3 | 00 | | | | 0 |

TABLE III.—CHRONIC

| Case No. | Type | Last colic | Last fever | Last parasites | X-ray | Operation | Gross pathology | | | Sections | Calculi |
|----------|--|------------|------------|----------------|-------------------------|------------------------|-----------------|----------|--------------------------------|----------|--|
| | | | | | | | Cystic | Common | Gall bladder | | |
| | | | 1 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 4799 | Colic, heart burn | weeks | | | NV Chol stone | E | P | P | Slightly thickened | N | chol pigment |
| 5240 | Colic, fever | 3 days | ? | | Non vis | E | ? | P | Small, greatly thickened | N+ | mixed Ca, no run |
| 5774 | Colic, indigestion, once vomited | days | | + old | NV Large Ca stone | E | Partly C | P | Normal | | 3 chol pigment Ca on wall duct |
| 5978 | Colic, jaundice, carious | Old | | ++ | Non vis Kalksteine | E | C | P | Large, thick, adherent carious | | 3 Kalksteine mixed Ca no run chol |
| 4163 | Fatty colic, indigestion | weeks | Charcot | | Non vis Ca stone | E | P | C | Dilated | ? | 5 chol with Ca in fracture. Large stone heavy Ca run |
| 5909 | Short sharp colic after meals | | | ? | Non vis | E | P | P | Dilated | | 5 chol Ca run ++ |
| 5995 | Mucy jejunal attack | Old | | ++ old | NV Ca stone | E | P | P | Slightly thickened | N | 10 Ca pigment berry type |
| 5613 | Colic with mild colic | 5 days | | weeks | N vis | E | C | P | Subacutely inflamed, thickened | | 3-6 chol |
| 5893 | Chronic R U Q pain, acid colic | | | | Non vis Ca stone | E | C | P | Thin and tense, stone in duct | 3-4 | CaCO ₃ |
| 6767 | Severe colic with deep jaundice | 4 days | | few days | NV | E | P | P | Large, white, tense | N | 100 chol |
| 693 | Severe colic | weeks | ? | | Non vis Calculi-ostomy | E | C | P | Flaccid, thickened | | 3-4 chol stones in Ca milk |
| 5707 | Colic, indigestion | | | | N. Flat plate | E | P | P | Normal | N+ | chol. Ca ring |
| 4934 | Colic, indigestion | Old | | | Non vis Ca stone | E | C | P | Normal | ? | mixed stone. Ca on one side |
| 5714 | Acute abdominal colic | | | | Non vis Ca stone | E | C | P | Small, tense adherent | | Small chol Ca run Kalksteine |
| 5994 | Colic, chills, fever | days | ? | | NV Mucy chol stones | E | P | P | Flaccid adherent | | 20 chol |
| 5581 | Atypical R U Q pain | Recent | Old | | NV Mucy chol stones | E | P | P | Thick | | 4 chol pigment |
| 5782 | Colic, indigestion | 3 weeks | | | Non vis large stone | E | C | P | Large, thick | 3 | Chol. pig CaCO ₃ |
| 5747 | Colic, jaundice, vomit | weeks | | + | Non vis | E | C | P | Adhesions, hydrops | | 7-8 chol no rings Ca pig. |
| 51400 | Colic and anorexia | Old | | | Non vis. | E | ? | P | Normal | 3-4 | 815 chol few Ca runs |
| 5319 | Mucy abdominal colic | day | | | Non vis | E | P | P | Large, white, and thick | | 1: chol. |
| 5944 | Chronic indigestion, one abdominal colic | Few days | | | Non vis. Large Ca stone | E | C | P | Small, thick, collapsed | N | Kalksteine Chol. duct stone |
| 494 | Mucy colic, O M? | Old | | | NV Large Ca stone | E | PH | P | Normal | N or | large dotted Ca no run |
| 5511 | Severe colic | months | | months | Non vis. Mucy Ca stone | E | C | P | White, thick, hard | | 6 diffuse Ca no rings |
| 5636 | No O B symptoms, sporadic on X-ray | | | | Ca stone NV | E | P | P | Normal | N | Ca pigment |
| 4877 | Severe colic with jaundice | Old | Old | Old | Non vis. | E Brown in common duct | Dilated | C partly | Slightly thickened | | 4 chol. pigment |

See Footnote for Table I.

TABLE III—CHRONIC

| Rile | | | | | | | | | | Sediment | | Total in G.B. | | G.B. wall | | Cultures | | P.O. Reaction |
|------|--------|-------------------|-------------------|---------|-------|-----------------|------|-------|-----|----------|----|---------------|------|------------|--------------|---------------------|---------------|---------------|
| ccm | W.B.C. | B.S. | Chol. | BS/Chol | Ca | CO ₂ | pH | Chol. | Ca | Chol. | Ca | Chol. | Ca | Chol. | Ca | Wall | Ble | |
| 11 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| | | 0 | 811 | | 40 | 32 | 6.06 | | | | | | | | | S | S | 0 |
| 0 | | 0 | + | 0 | | | | | | | | | | | | | | 0 |
| 19 | | 344 | 128 | 3 | | | | | | 24 | 33 | | | | | | | |
| | | 0 | qual. | + | qual. | + | knag | | | | | | | | | S | S | 0 |
| 8 | | 1577 | 36 | 44 | | | | | | 2 | 88 | | | | | S | S | 0 |
| 15 | 176 | 1267 | 93 | 3 | 38 | 33 | 6.6 | | | 33 | 12 | 320 | 778 | B. coli | | B. coli innumerable | | 0 |
| 33 | 450 | 6151 | 375 | 16 | 42 | 24 | 7.00 | 37 | | 83 | 9 | 320 | 000 | S | | S | | 0 |
| 0 | 1150 | 0 | 33 | 0 | | 17 | 6.5 | | | 3 | | 3640 | 170 | B. typhosa | | S | | 0 |
| | few | 0 | 0 | 0 | 10.6 | 11.2 | 6.8 | | | | | | | | | S | S | + |
| 18 | 350 | 37 | 114 | 33 | 41 | 30 | 6.91 | 1 | 35 | 21 | 7 | 3 | 1080 | 680 | Scaph. aurea | | S | 0 |
| | | 0 | qual. | + | qual. | | knag | | | | | knag | | | | S | S | 0 |
| 21 | 1202 | 128 | 9 | 1 | 9 | | | | | 31 | 74 | 7 | 36 | | | S | S | 0 |
| | 0 | | | | 15.4 | 20.5 | 6.8 | | | | | | | | | S | S | 0 |
| | 0 | | | | 14.3 | 14 | | | | | | knag | | | | S | S | 0 |
| | 310 | 188 | 7 | | | | | | | | | | | | | S | S | 0 |
| | 738 | 96 | 8 | | | | | | | | | | | | | B. coli | B. coli | ++ |
| 18 | 0 | 114 with crystals | 0 | 0 | 1 | 6.6 | | | | | | | | | | S | S | 0 |
| | 0 | 343 with crystals | 0 | 352 | 8 | | | | | | | | | | | S | S | 0 |
| 1 | 0 | 500 with crystals | 0 | | | | | | | 3 | | | | 405 | 130 | Green strep. staph. | B. welchii | 0 |
| 18 | 3460 | 1375 | 73 | 10 | 44 | 47 | 7.7 | 2 | 8 | 018 | 9 | 83 | 1 | 204 | 243 | S | S | 0 |
| | 0 | 0 | 0 | 103 | 53 | 7.8 | | | | | | knag | | | | S | B | 0 |
| 0 | 2400 | 524 | 44 | 33 | 87 | 49 | 6.81 | 0 | 8 | 2 | 6 | 5 | 23 | 800 | 6400 | Staph. B. welchii | Strep. 30 | 0 |
| 26 | 3184 | 0 | 9 | 0 | 13 | 3 | 11.6 | 6.8 | 023 | | 8 | 67 | 3 | | | S | Few staph. | 0 |
| | | | | | 31 | 3 | 8.1 | 7 | 21 | | | | | | | | | 0 |
| 2 | | 260 | 500 with crystals | 3 | | | | | | 10 | | | | 375 | 140 | B. coli | B. coli, many | |

TABLE IV—BACTERIAL FINDINGS IN DIFFERENT TYPES OF GALL BLADDERS

| | Sterile | Infected* |
|--------------------|---------|-----------|
| Normal | 3 | 3 |
| Normal with stones | 3 | |
| Acute | 3 | 6 |
| Chronic | 7 | 10 |
| | 4 | 8 |

*If bacteria are found in either bile or gall-bladder wall.

TABLE V—BACTERIAL FINDINGS IN RELATION TO CYSTIC DUCT PATENCY

| | Sterile | Infected* |
|-------------|---------|-----------|
| Duct open | | |
| Acute | 4 | 3 |
| Chronic | 8 | |
| Duct closed | | |
| Acute | 3 | 8 |
| Chronic | 0 | |

*If bacteria are found in either bile or gall-bladder wall.

5 *Chronic cases* (Table III) In this case all had stones and most but not all had definite pathological findings in the gall bladders and had definite histories of undoubted attacks of biliary disease.

Microscopic studies These are being reported in detail in another paper but a short summary of the findings thus far will be given here. The first observation was the decided difference with which the tissue behaved when put into fixatives. In many cases a gall bladder which had seemed thickened in the fresh specimen failed to contract in formalin. Others that were quite thin in the fresh specimen contracted to such an extent that in section they appeared very thick. This lack of correlation was so striking that at first it was thought that specimens might have been mislabeled. No reason for this has been found so far. Second the mucosa, in the great majority of cases was surprisingly normal even in the acute cases. By the technique described it at once becomes evident that the mucosa is well preserved in most cases, and the villi are intact. Third the severity of the inflammatory changes is greatest nearly always in the serosa. In other words the inflammation seems to reach the gall bladder from without and not from the bile. This was suggested by us in a previous article (4). Fourth, the degree of inflammatory changes discovered histologically is not commensurate with the symptoms produced and the walls of these gall bladders are not comparable with the walls of other inflamed viscera, such as the appendix or urinary bladder. In other words the changes found are quite possibly due in the vast majority of cases to obstruction or some such factor and not to infection *per se*.

Cultures (Tables I-III columns 26-27) In view of the elaborate nature of the technique followed, the small number of bacteria found in most cases has been surprising. In 25 cases

both gall bladder wall and bile were sterile and in 28 one or the other contained organisms. Biliary tract infection did not seem to be significantly higher in any one group of the classification than the other (Table IV). Thus, while half of the normals contained bacteria, actually less than half of the entire infected group did. On the other hand, the finding of bacteria was about twice as common in the acute 59 per cent as in the common cases, 28 per cent. If these statistics are re-arranged according to whether or not the cystic duct was patent, an interesting fact is seen (Table V). If the duct is patent, there is no significant difference between the acute and chronic cases, but if the cystic duct is closed the acute cases gave bacterial growth in 8 of 11 cases but in the chronic group it was sterile in 9 out of 10 cases. This agrees well with our previously reported experiences in animals (4) that closure of the cystic duct brings about an infection of the gall bladder and that eventually the organ sterilizes itself and lies as a functionless viscus without causing harm unless reinfection occurs.

The route through which the infection occurs also is shown. There were 7 cases in which the gall-bladder wall contained bacteria and the bile was sterile. This contrasts sharply with only two in which the wall was sterile and the bile contained organisms. In these 2 cases only small numbers of staphylococci were present in the bile. Throughout the entire series the organisms found in the bile were very few in numbers, compared to the rich growth often found in the wall. When one considers the facts brought out by Arnold, as to the enormous number of bacteria which pass out of the digestive tract into the lymph stream and the finding of a rich flora in the normal liver reported in our studies on liver autolysis (3-8) one cannot help feeling that these organisms represent the normal flora of the

region derived from the gastro-intestinal tract. This is further borne out by the wide variety of bacteria found *Bacillus welchii*, streptococci of several kinds, including *faecalis alcalescens*, *Staphylococci*, *albus aureus*, and a hæmolytic type, *Diphtheroids*, and *Bacillus Typhosus*. Our results then indicate that infection reaches the gall bladder from without and not from within, and correspond well with the microscopic studies.

The colon bacillus appears to be a striking exception to these statements. In the first place, when present at all, it generally can be recovered in enormous numbers. Instead of ranging from a few to 100 per cubic centimeter, it is usually over five million per cubic centimeter which was about the limit of possible counts by the dilutions used in making the plates. Its association with the more severe cases was quite unusual. It was found in 9 cases. In 3 the patients died, a fourth patient developed a large postoperative abscess in the gall bladder bed in the fifth profuse wound suppuration occurred resulting in a hernia, in the sixth, the patient had a fever to 105 degrees following cholecystectomy. The seventh patient nearly died of paralytic ileus and enormous distention. Of the 2 remaining cases 1 had only a few organisms per cubic centimeter of bile. From these figures then it seems that the colon bacillus was associated with most of the postoperative disasters in the entire series reported, and its presence is of grave prognostic significance, it being the only organism which appears in enormous numbers in the bile. In this series there was no case of really totally gangrenous gall bladder, and the Welch bacilli were not found in large numbers in any culture. Their presence in small numbers did not seem to have any prognostic significance. They appear simply to represent portions of the normal liver flora. Our previous finding of these organisms in gangrenous gall bladders is probably explained on this basis, and we no longer regard it to be of grave significance.

Pus in the bile In such a short series there were naturally but few cases of empyema of the gall bladder. However, when apparently found, we were surprised to find that the diagnosis would not stand up under more detailed

TABLE VI—BILE SALTS AND CHOLESTEROL IN DIFFERENT TYPES OF GALL BLADDERS

| | Bile salts | Cholesterol | B.S.-Chol. Ratio |
|--------------------|------------|-------------|------------------|
| Normal | 1347 | 158 | 11 |
| Normal with stones | 1778 | 159 | 14 |
| Jaundice | 2060 | 157 | 13 |
| Acute | 108 | 178 | 5 |
| Chronic | 811 | 144 | 5 |

Ratio figured from averages of bile salts and cholesterol, not average of individual ratios.

analysis. When smears and white counts were made, the "pus" resolved itself into a mixture of debris made up of small cholesterol crystals, fine amorphous cholesterol in suspension, calcium, and pigment debris. This is shown very clearly in the white blood counts made in the bile. A study of these counts (column 13 in Tables I-III) shows at once that pus is not found in the bile. In the acute or chronically infected cases no more than the normal wandering cells were shown and no relation could be made out between this and any other factor. In several of the severely infected cases the count was actually lower than normal. Again a striking exception is one of the *Bacillus coli* cases which developed a postoperative abscess. It was the only one in the entire series with a significant elevation of the white count. These results also militate strongly against any theory of biliary origin to gall bladder disease.

Bile salts and cholesterol The findings in this series agree closely with our previously reported animal experiments. A summary of the data is given in Table VI. The following points are to be especially noted:

a. The bile in normal gall bladders without stone contains about 20 times as much bile salts as cholesterol amply sufficient to hold the latter in solution and thus prevent stone formation. In the case of normal gall bladders containing stones the ratio is slightly lower about 14 and quite near the critical level for precipitation. Here, as in many of the later classifications, isolated cases may be found by consulting the large tables (I-V) where cholesterol stones are found in bile far below the saturation point. This emphasizes the well known fact that even cholesterol stones are not soluble in human bile to any appreciable extent. As we previously showed the cholesterol is in a chemical combination with the bile acids, and its precipitation is an irreversible

TABLE IV—BACTERIAL FINDINGS IN DIFFERENT TYPES OF GALL BLADDERS

| | Sterile | Infected* |
|--------------------|---------|-----------|
| Normal | 3 | 3 |
| Normal with stones | 2 | |
| Mucous | 3 | |
| Acute | 7 | 14 |
| Chronic | 14 | 8 |

*If bacteria are found in either bile or gall-bladder wall.

5 *Chronic cases* (Table III) In this case all had stones and most but not all had definite pathological findings in the gall bladders and had definite histories of undoubted attacks of biliary disease.

Microscopic studies These are being reported in detail in another paper but a short summary of the findings thus far will be given here. The first observation was the decided difference with which the tissue behaved when put into fixatives. In many cases a gall bladder which had seemed thickened in the fresh specimen failed to contract in formalin. Others that were quite thin in the fresh specimen contracted to such an extent that in section they appeared very thick. This lack of correlation was so striking that at first it was thought that specimens might have been mislabeled. No reason for this has been found so far. Second the mucosa, in the great majority of cases was surprisingly normal, even in the acute cases. By the technique described it at once becomes evident that the mucosa is well preserved in most cases, and the villi are intact. Third, the severity of the inflammatory changes is greatest nearly always in the serosa. In other words the inflammation seems to reach the gall bladder from without and not from the bile. This was suggested by us in a previous article (4). Fourth, the degree of inflammatory changes discovered histologically is not commensurate with the symptoms produced, and the walls of these gall bladders are not comparable with the walls of other inflamed viscera, such as the appendix or urinary bladder. In other words, the changes found are quite possibly due in the vast majority of cases to obstruction or some such factor and not to infection *per se*.

Cultures (Tables I-III, columns 26-27) In view of the elaborate nature of the technique followed, the small number of bacteria found in most cases has been surprising. In 25 cases

TABLE V—BACTERIAL FINDINGS IN RELATION TO CYSTIC DUCT PATENCY

| | Sterile | Infected* |
|-------------|---------|-----------|
| Duct open | | |
| Acute | | 3 |
| Chronic | 4 | |
| Duct closed | | |
| Acute | 3 | 2 |
| Chronic | 9 | |

*If bacteria are found in either bile or gall bladder wall.

both gall-bladder wall and bile were sterile, and in 28 one or the other contained organisms. Biliary tract infection did not seem to be significantly higher in any one group of the classification than the other (Table IV). Thus while half of the normals contained bacteria, actually less than half of the entire infected group did. On the other hand the finding of bacteria was about twice as common in the acute 59 per cent as in the common cases, 28 per cent. If these statistics are re-arranged according to whether or not the cystic duct was patent, an interesting fact is seen (Table V). If the duct is patent, there is no significant difference between the acute and chronic cases but if the cystic duct is closed, the acute cases gave bacterial growth in 8 of 11 cases but in the chronic group it was sterile in 9 out of 10 cases. This agrees well with our previously reported experiences in animals (4) that closure of the cystic duct brings about an infection of the gall bladder and that eventually the organ sterilizes itself and lies as a functionless viscus without causing harm unless reinfection occurs.

The route through which the infection occurs also is shown. There were 7 cases in which the gall-bladder wall contained bacteria and the bile was sterile. This contrasts sharply with only two in which the wall was sterile and the bile contained organisms. In these 2 cases only small numbers of staphylococci were present in the bile. Throughout the entire series the organisms found in the bile were very few in numbers, compared to the rich growth often found in the wall. When one considers the facts brought out by Arnold, as to the enormous number of bacteria which pass out of the digestive tract into the lymph stream and the finding of a rich flora in the normal liver reported in our studies on liver autolysis (3, 8) one cannot help feeling that these organisms represent the normal flora of the

tion of precipitated substances from bile is very difficult. Amorphous cholesterol is often in such a fine state of dispersion that it will pass through filter papers. Centrifuging is the method of choice and usually yielded perfectly clear supernatant fluids. The striking fact elicited from these studies was the very small amount of cholesterol found in any of the sediments. It was so little as to be insignificant in every case, the highest figure being under 3 milligrams, in most cases being under 1 milligram, although the total amount of the sediment might be considerable. This seems to indicate that cholesterol stones are formed and grow by actual crystallization of cholesterol on nuclei or stones and not by agglomeration of amorphous sediment into masses. Such finely divided cholesterol is probably carried out through the cystic duct if it is open and, if not, is removed by wandering cells.

The same is true although in a lesser degree of calcium. It is not found often in large amounts in the sediment, except in the cases of *Kalkmilchgalle*. In other words it seems that the calcium is precipitated directly onto stones and not molded onto them from the sediment.

The sediment consists of a mixture of organic compounds, proteins and their derivatives fatty acid, fats, and contains a minimum of stone forming substances, except pigment which is often found in considerable quantities.

Total quantities in the gall bladder. These are given in columns 22-23 in Tables I-III. It is evident that in general the normal gall bladders contained the most material. If these figures are studied in relation to the patency of the cystic duct, it becomes quite clear that the function of the closed viscus is an absorptive and not a secreting one. Much less cholesterol is found in closed gall bladders, and as has been before stated the bile salts are rapidly absorbed.

The conspicuous exception is calcium which as has been shown by Phemister and by our selves is excreted by the gall bladder mucosa.

Calcium. Wilkie has reported the finding of calcium gall stones in animals after bacterial injection and cystic duct ligation. Phemister (24) successfully repeated these experiments and called attention to the fact that in the

TABLE VIII—CALCIUM IN THE BILE

| | |
|------------------------------|----|
| Normal (6 cases) | 33 |
| Normal with stones (4 cases) | 17 |
| Acute (10 cases) | 36 |
| Chronic (13 cases) | 36 |

Figures in mg per cent.

clinic calcium gall stones were definitely associated with cystic duct closure. Our own experiments showed that infection was not necessarily a factor, first as calcium was rapidly absorbed from the acutely infected gall bladder (5), and second because this calcium excretion was experimentally reproduced with out infection (2). The analyses in this series confirm these findings. Table VII shows that the bile entering the gall bladder is not a significant factor as its calcium content is not changed appreciably from the normal in diseased cases. In a recent paper (5) a series of 45 calcium estimations on dog bile gave results which are almost identical with those in Table VIII. It appears then that, during the early stages of obstruction and consequent infection, the gall bladder absorbs not secretes calcium, but later after conditions have become quiescent, a distinct excretion occurs. Reference to the large tables (I-III), however shows that if the duct is closed the calcium in solution (column 17) is small in amount in the acute cases but in the chronic or quiescent cases it tends to run higher or even produce *Kalkmilchgalle*.

Reaction of bile (Tables I-III, columns 18-19). The hydrogen concentration of the bile or gall bladder contents varied only in a narrow range and these changes did not seem to bear any relation to any other factors in these studies. They were far less than the changes in reaction reported by Rous between liver bile and bladder bile, and no conclusions can be drawn, except that our work does not show that the hydrogen ion concentration bears any relation to gall bladder disease. The carbon dioxide combining power (Van Slyke) also gave results from which no conclusions may be drawn. It varied over an exceedingly wide range, and could not be shown to bear any relation to the hydrogen ion concentration, the chemical content of the bile, or the condition of the gall bladder.

Gall-bladder wall (Tables I-III, columns 24-25). The enormous variations in the content

of the gall-bladder wall in cholesterol and calcium are striking but appear to follow no consistent rule that we can make out. The fluctuations are so great that it seems a logical deduction that either excretion or absorption is going on but in which direction the flow is cannot be ascertained. Especially disappointing has been the attempt to correlate the histological picture with the chemical one. This has been due perhaps to the fact that in straw berry gall bladders, the deposits tend to be local and a section of one part and chemical analysis of another would naturally yield discordant results. In work under way now attempts are being made to correct this.

DEDUCTIONS

Considering the data enumerated together with our recent experimental studies, it is possible to build up a fairly comprehensive although tentative theory as to the origin and progress of gall bladder disease.

1 To the perennial question as to whether the infection precedes the stone or vice versa, the answer may be given that the evidence is in favor of the infection being the causative agent. After considerable experimental work as well as clinical studies, no evidence is forthcoming that the liver ever secretes bile at the saturation point (7-13). There is no evidence that gall stones *per se* are associated with hypercholesterolemia or even that hypercholesterolemia will cause an increased amount of sterols in the bile. Finally a definite mechanism has been demonstrated by which infection will cause stones (9).

2 The possible routes for this infection are three: hematogenous, chologenous and by direct extension from the liver. In animal experiments most enormous doses of bacteria intravenously are needed to cause a cholecystitis, far more than ever happens clinically. As to a biliary origin although numerous authors report the passage of injected bacteria into the bile again the doses used are beyond reason. Graham has shown that the liver acts as a rather efficient filter and will hold back injected bacteria in amounts that exceed those found in human blood except in most severe bacteremia. On the other hand,

the rich flora of the liver affords an obvious and simple explanation. Dragstedt (14) showed that the Welch bacillus was a constant inhabitant of the normal liver. Our own work has confirmed this and also demonstrated that this viscus contained most of the intestinal flora in considerable numbers. The prompt infection of a dog's static gall bladder with this flora is easily demonstrated (4). The observations reported in this paper lend strong support to the view that the liver is the source of the infection. In the few cases in which high bacterial counts as well as the stormy course indicate marked infective process, the colon bacillus was the offending agent and it seems reasonable to assume that it is the actual cause of the first cholecystitis which causes stone formation.

3 Sections through the cystic duct and the lower end of the gall bladder show a surprisingly complex arrangement of valves and folds. This is so marked as to lead some observers to question whether the gall bladder can ever empty itself. It is quite clear that the least swelling or edema in this region would promptly close off the duct. After the first small stones have been formed it may then act as a stopper in subsequent attacks and cause stasis, either temporary or permanent. The overwhelming majority of our cases which showed pathological change had stones and besides the paucity of bacteria, even in the acute ones, indicates that mechanical obstruction is the important element in most attacks, and only rarely will a patient be operated upon in the first attack in which the bacteria are the offending agents.

4 The train of events being thus initiated each subsequent stoppage of the duct with resulting infection, brings about further absorption of bile acids with further deposits of cholesterol on the stones. If the stasis is of short duration, as is usually the case, the deposit is cholesterol. If it is prolonged the infection tends to clear up as we have shown in animal experiments and the secretion of calcium from the gall bladder wall results in calcium rings about the stones or in fractures in the stones. A resolution and recurrence of short septic attacks may thus result in alternate layers of calcium and cholesterol. Com-

plete, permanent stoppage results in *Kalkmilchgalle* or pure calcium stones.

5 Pigment studies are handicapped by lack of suitable microchemical methods. However, the following facts are clear. Pigment is not precipitated as a simple calcium salt, the amount of calcium being far too great for this. Cholesterol stones seldom have pigment nuclei. Pigment is usually associated with calcium in gall stones. Pigment stones may result from supersaturation as in hæmolytic jaundice, and in the common bovine gall stones. These stones form readily in experimental animals in any condition characterized by inspissation of the bile, they even form in the dilated ducts of dogs with common duct ligation. All that one can say of them is that under condition of concentration, increased excretion with perhaps the factor of changing reaction of the bile, pigment may be precipitated. This is deposited in amorphous masses in and about gall stones, and under rare conditions may be precipitated in a pure state.

The question of chemical cholecystitis. Several points in our work might easily lead to the interpretation that cholecystitis is not a bacterial disease. These points are, the many sterile gall bladders found in acute cases the low white counts in the bile and the lack in many cases of the microscopic picture of an acute infection.

There are other facts available which point in the same direction. First, there is the experimental method of producing gall bladder inflammation in dogs by the intravenous injection of Dakin's solution (21). Second is the demonstration by Wolfer that pancreatic juice will provoke a cholecystitis. This has been confirmed in our laboratory (1). Third, the report by Judd (23) of numerous cases of apparently acute cholecystitis which yielded sterile cultures.

Therefore with these several points in mind it is very difficult to deny the possibility of the entrance of a sterile irritant, such as pancreatic juice, even duodenal content into the gall bladder. Excretion by the liver of bile containing chemical irritants is also a possibility. The answer to these questions must await more careful chemical analysis of bile from acute cases.

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PARAVERTEBRAL ANÆSTHESIA IN OBSTETRICS

EXPERIMENTAL AND CLINICAL BASIS¹

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PAIN in labor, in spite of the remarkable advances in anæsthesia during the past quarter of a century, still remains a necessary concomitant of normal delivery. There seem to be two valid reasons for this first, the disadvantages of general anæsthesia and/or narcosis are enhanced in obstetrics by the peculiarly long period of administration, producing toxic effects on the child, the mother, or the uterus itself, which contra indicate adequate dosage, second, the lack of definite knowledge concerning the paths of afferent nerves of the uterus to the cord, has prevented the scientific application of regional anæsthesia.

Regional anæsthesia, so successfully developed in other fields of surgery, should find its ideal application in obstetrics if a method were developed whereby the sensory nerves could be blocked without appreciably affecting the motor nerves of the uterus. In this field, spinal anæsthesia not only lacks the safety of other forms of regional block, but also impairs the expulsive power of the uterus, whereas, caudal block does not relieve the pain of uterine contraction. Paravertebral block of nerve roots has not apparently been tried owing to the large number of them attributed to the uterus by clinical observations of areas of hyperæsthesia.

The purpose of this paper is to survey the present status of our knowledge of uterine afferent nerves, to present experimental proof *via* visceromotor reflexes of the location of these paths in the dog, to correlate these findings in man, to explain the error of conclusions hitherto accepted, and to demonstrate that the pain of uterine contraction may be abolished without affecting the contractions by paravertebral block of only two adjacent nerves.

PRESENT STATUS OF KNOWLEDGE OF AFFERENT NERVES OF THE UTERUS

Much conflicting evidence has been published on the afferent supply of the uterus

Behan considered these fibers to be of cerebro-spinal rather than sympathetic origin, that they come from the second, third, and fourth sacrals or the third and fourth sacrals—and that it is due to stretching of these nerves that pain is felt in labor. Nevertheless, experiments of caudal anæsthesia in labor at the Royal Victoria Maternity Hospital, Montreal, in 1927, demonstrated that although relaxation and insensitivity of the perineum and adjacent parts indicated that the sacral nerves had been successfully blocked, the labor pains were undiminished. These experiments are in accord with the salient fact discovered by Cotte, 1925, that all pain of uterine contraction in dysmenorrhœa, is abolished by section of the superior hypogastric plexus. Leriche and Stricker, 1927, demonstrated the presence of sensory fibers in this plexus, and Fontaine and Hermann 1932, proved that dysmenorrhœa and other forms of severe pelvic pain may be consistently relieved by its section as high as the inferior mesenteric ganglion but its position on the anterior aspect of the aorta makes it too inaccessible for practical regional block. It is necessary, therefore, to trace the uterine afferents to the nerve roots.

Evidence on the afferent connections of the uterus with the cord, by clinical observation of areas of hyperalgesia, is contradictory and inconclusive. Head found the pain of labor to be associated with tenderness over the eleventh thoracic segment definitely, often the twelfth, too, sometimes the tenth and occasionally the first lumbar, and the after pains to be associated with the third sacral, as well as all these. MacKenzie observed that pain is felt between the umbilicus and pubis, across the back at the level of the top of the sacrum, and rarely referred to a lower level, but that it may extend from the tenth thoracic to the third lumbar nerves. Pottenger, while admitting that clinical observation of pain and sensation must of necessity be more or less uncertain,

¹These investigations were begun at McGill University, 1927, and carried to completion at the University of Oregon, Department of Physiology with the co-operation of Professor G. E. Berger, 1930-1932. The clinical application was made at the Oregon City Hospital, 1932.

believed that uterine pain may be located anywhere in the areas of the tenth thoracic to the fifth lumbar or even sacral segments. Head's conclusions are quoted in Cunningham's *Anatomy*. Clinical observations indicate that afferent impulses reach the central nervous system from the uterus through the posterior roots of the tenth, eleventh, twelfth thoracic nerves, the first lumbar, and the second, third, and fourth, sacral nerves. Kuntz, in his recent thorough and exhaustive text on the autonomic nervous system, 1929, gave these roots as bearing uterine afferent fibers for which his reference was Cunningham. Yet, in 1922, Head recognized and explained the variability of these areas of hyperesthesia, summing up his long unexcelled experience in these words: "Referred pain of visceral origin and the tenderness which accompanies it may be confined to the territory of a few segments only representing the nerve supply of the affected organ. But in the larger number of cases met with in daily practice this is not the case. If the stimulus is extremely severe—as for example, during an attack of gall stones or renal colic, the pain may spread widely even in otherwise normal persons. That this is true of the severe stimulus of labor is supported by the observations of Gertsmann, 1926, when he reported a case of gestation in a woman with a lesion of the cord at the level of the first lumbar vertebra in which sensory and motor powers of the uterus were retained. He quoted Langley and Anderson in affirming that the sacral nerves did not take part in the innervation of the internal generative organs."

VISCEROMOTOR REFLEXES AS AN INDEX OF AFFERENT NERVES

In 1909 MacKenzie, having demonstrated clinically that abdominal muscles possess the power of contraction in small sections in response to visceral stimulation, coined the phrase "viscero-motor reflex." He considered this to be due to hyperirritability of the spinal cord in the vicinity of the visceral afferent neurones. He concluded that as the motor supply is better known than the sensory, we might by this means more accurately ascertain the segment of stimulation in the cord. Never-

theless, in the absence of a means of accurately marking out the limits of motor activity, he based his conclusions in regard to the afferent supply of the viscera on sensory disturbances.

A method of recording visceromotor reflexes and of using them as an index of the afferent connections to the cord of any particular viscous, was worked out on the spleen by Cleland and Tait, 1926, cats and dogs being used. It was found that widespread synapses occur within the cord from the limited afferent neurones to the extensive efferent neurones of the same organ. Since experience in 1927 with caudal anesthesia in labor seemed to dispose of the idea of the sacral distribution of uterine afferents as erroneous, it was apparent that the afferent nerves of the uterus must enter the cord higher up—probably within the compass of the visceromotor reflexes.

Owing to the relatively greater number of thoraco-lumbar segments and relatively fewer sacral segments in the dog than in man, the problem of applying uterine afferent findings in the dog (by analogy) to man, would be difficult were it not for the works of Edgeworth and Head. Edgeworth, 1892, found the visceral afferent fibers to enter the cord in the dog between the first thoracic and the third lumbar and between the seventh lumbar and the second sacral, thus leaving a gap of three segments. Head, 1893, found that in the human the distribution of the afferent sympathetic to the cord is between the first thoracic and the first lumbar and between the fifth lumbar and the fourth sacral, thus leaving a gap of three segments. Since in each case the lower limit of the sympathetic distribution is the next to last sacral, one may counting from below upward infer that the fourth lumbar in the dog corresponds to the second lumbar in man. Johnston, 1906, found that in all higher classes of vertebrates the arrangement of the spinal nerve roots along the trunk is the same. The relationship of afferent and efferent neurones in the cord according to Pottenger, 1922, is preserved in the process of evolution and while some of the viscera are markedly displaced, they still keep their primitive nerve connections. The constancy of the analogy is further substantiated by the works of Bardeen, Ramstrom, and Sherrington.

POSSIBLE EFFECT OF PARAVERTEBRAL BLOCK

That pain in labor may be relieved by paravertebral block of nerve roots is suggested by Kappis' work on other organs. A comparison of his findings of the afferent roots from particular viscera, with those of Head and others, show them to be much more limited in extent than areas of hyperalgesia have suggested. Nevertheless (perhaps because of the clinical impracticability of blocking the extraordinarily large number of segments attributed to it by areas of hyperalgesia) he did not, apparently, attempt to thus block uterine pain. Sweetlow 1926 relieved angina pectoris, in a case with hyperalgesia of the first and second thoracic segments, by paravertebral injection with novocain of the first and second thoracic roots, whereas Head's area of hyperalgesia for the heart extends from the first to the seventh thoracic.

Gertsman 1926 referred to the experiments on animals of Ludwig, Muller Balint, and Benedict to show that the primary centers for contraction of the uterus must be situated *outside* the cord, and in the sympathetic ganglia of the pelvis. This is borne out by the experiments of Sir James Simpson, 1871 when he found that parturition was normal in sows from which he had removed the thoracic and lumbar cord except that the last fetus of the litter remained in the vagina. That this was also true of the cat was shown in a similar experiment by Riemann 1871. Rein, 1882, noted that spontaneous parturition in the rabbit, following the section of all the extrinsic nerves of the uterus, proceeded with abnormal rapidity. Cannon, 1929, reported parturition in a cat 6 weeks after the exclusion of all sympathetic impulses by removal of the sympathetic ganglia, and normal parturition has occurred in patients after resection of the superior hypogastric plexus had been previously performed for the relief of pelvic pain (Fontaine and Hermann). Moreover, Delle plane and Badino 1927, skillfully blocked this plexus by deep paravertebral injection, and relieved pain of uterine contraction without obstructing the course of labor. Whitehouse and Featherstone investigated the cause of increased tone and contraction of uterine muscle under spinal anæsthesia and decided that it

was due to the effect of paralysis of the lumbar cord on the para sympathetic, third and fourth lumbar (thus contracting the circular muscle and relaxing the longitudinal or expulsive muscle). They inferred that paralysis of the sympathetic would have the opposite effect. Since it has been shown that the primary centers for uterine contraction lie in or beyond the sympathetic ganglia, however it would appear that the blocking of a limited number of sympathetic roots should not interfere with the motor activity of the uterine muscle. Therefore should the uterine afferent sympathetic be found to be more limited segmentally than the uterine efferent sympathetic (as was shown to be the case with the spleen) paravertebral block should relieve the pain of labor without interfering with its normal course.

TECHNICAL DETAILS OF EXPERIMENTS¹

The animals used for experiment were dogs and cats.

Since it was found that all anæsthetics and narcotics in doses adequate to prevent pain, depress the reflexes, the spinal animal, with the cord transected just below the foramen magnum was used. Artificial respiration was supplied by an air pump. To compensate for the fall in temperature normally appearing in the spinal animals, heat was applied by means of an electric reflector.

Stimulation of the visceral organ was effected either by minimal induction shocks through shielded electrodes to the organ, or its nerve or by dilatation of the organ (with normal salt solution). The latter method was finally chosen as a more physiological one for the uterus. It was effected by means of a pressure bottle and rubber tubing to a Y tube cannula tied in the cervix. As a pressure gauge, a mercury manometer was interpolated by a T tube connection, between the pressure bottle and the cannula. To produce a sudden intra uterine pressure the bottle was elevated to the desired height, and the pressure clamp released whereas the more usual gradual distention was applied by pumping air into the pressure bottle by means of a sphygmomanometer bulb.

Changes in muscle tonus were recorded on a revolving smoked drum by means of a spring lever actuated by a silk thread attached to the cut end of the muscle. The spring was adjusted so as to balance the normal tonus of the muscle and the direction of the thread was bent, by pulleys, into alignment with muscle fibers. Contraction of the muscle thus produced a downward motion of the lever against the spring, to be recorded on the drum. A second spring

¹ My thanks are due Dr. G. E. Berger for having provided facilities and help for these experiments, and for his invaluable assistance both with them and this manuscript.

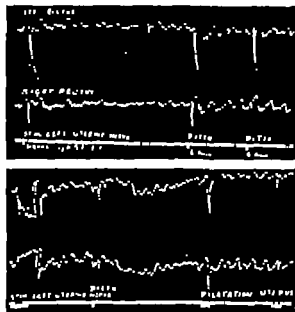


Fig. 1 To show that dilatation of the uterus is an adequate stimulus to its sensory nerves; and also some characteristics of the uterine visceromotor reflex. Contraction of the rectus produces a downward movement of the recording lever. Graph I.

lever was set directly below the other so that changes in tonus of two muscles (usually on opposite sides of the abdomen) could be recorded simultaneously.

The moment of stimulation was recorded by a signal marker on the drum actuated by a key that closed the circuit and produced the stimulation at the same time. A timer recorded two second intervals. The drum was made to revolve at the rate of $1\frac{1}{4}$ inches per minute.

In order to immobilize the place of origin of the muscles, the pelvis was rigidly held by a strong clamp applied to the sacral tuberosity and fixed to the table.

IDENTIFICATION OF NERVES FROM THE FALLOPIAN TUBE AND UTERUS

Nerves were traced to the inferior mesenteric ganglion in the dog from the fallopian tube and the uterus by two entirely different routes. Nerve fibers from the fallopian tubes converged lateral to the ovary to form a nerve trunk which accompanied the ovarian artery for a distance of 2.5 centimeters, then passed caudally and medially, and subperitoneally to the inferior mesenteric ganglion. The uterine nerve, made up of fibers which accompanied the branches of the uterine artery from four segments of the uterus, was joined by nerve fibers from the cervix and vagina, and coursed along the uterine artery to a point 2 centimeters caudad to the cervix. From this point it was traced subperitoneally to the inferior

mesenteric ganglion. Nerve fibers were teased out under the binocular dissecting microscope, and afferent fibers were identified under the high power microscope.

Before proceeding to the identification of the uterine afferent nerves, I found it necessary to determine the physiological adequate stimulus and to study the characteristics of the normal visceromotor reflex produced.

DETERMINATION OF ADEQUATE IMPULSE AND OF CHARACTERISTICS OF NORMAL UTERINE VISCEROMOTOR REFLEX

A female non-pregnant dog, was prepared for the recording of the visceromotor reflex. The peritoneal cavity was opened by a small midline incision just above the pubis, and the uterus delivered. The shielded electrode was applied to the left nerve at the level of the cervix, the vagina was opened in the midline, anteriorly and a suitable cannula was inserted in the cervix. A suture was applied around the cervix (care being used to avoid the inclusion of any other structure such as the sympathetic ganglion posteriorly) to prevent leakage. The cut edges of the vagina were then sutured around the cannula to arrest bleeding. Care was taken to restore the uterus to its normal position, thus preventing any tension on its nerves or attachments. The lower abdomen was then closed, in three layers, so as to prevent the incidental production of extraneous impulses from the viscera or peritoneum, and as a means of supporting the cannula steadily in place. The recording apparatus was then adjusted so as to balance the normal tonus of the muscles with the levers leveled.

The secondary coil was advanced until stimulation of the left uterine nerve produced a strong visceromotor contraction of the left rectus, and a lesser contraction of the right rectus. The pressure bottle was then gradually elevated until it was found that the sudden application of a pressure of 100 millimeters of mercury sufficed to produce a strong simultaneous contraction of both recti. When the pressure was gradually applied, a similar reflex occurred. As illustrated in Figure 1 dilatation of the uterus produced a visceromotor reflex of precisely the same character as that produced by stimulation of the uterine nerve—preceded by the same latent period and followed by a similar refractory period.

The indirect slight reflex contraction produced in the right rectus by stimulation of the left uterine nerve had double the latent period of that produced in the left rectus—indicating the presence of intercalating neurones across the cord, and the relatively direct relation of the afferent and efferent neurones of the visceromotor reflex arc on the same side (Fig. 1).

A long series of experiments was performed on dogs and cats in various stages of pregnancy in the postpartum period, and in non-pregnant animals

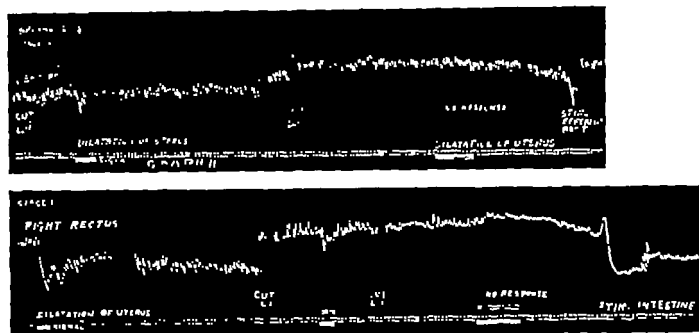


Fig. 2. To illustrate experiments to determine the nerve roots which carry the sensory fibers from the uterus. Series A, i.e. with minimum adequate stimuli (Graph II) Stage I (above) shows the upper limit to be the first lumbar. Stage II (below) shows the lower limit to be the second lumbar.

before the unusual characteristics of the uterine reflex were established. The reflexes occurred consistently even when the muscle was in a state of tremor. A gradual progressive fatigue of reflexes, however, began after a variable period averaging 2 hours (depending upon the condition of the animal and the extent of the operation performed upon it), but the latent period tended to remain the same. Since the visceromotor reflexes disappeared while the animal was still in good condition an unusually long series would be necessary to determine the uterine afferent nerves. It was found that pregnant animals were unsuitable because the uterine visceromotor reflex was in a refractory state. Although it was found that the refractory state could be removed by intravenous injection of adrenalin the effect was too transitory to be of practical value in this work. Incidentally adrenalin produced an initial contraction of the rectus fully as strong as that produced by visceral stimulation—indicating a relationship between the sympathetic system and skeletal muscle tonus. It was also found that afferent impulses from the uterus during the first 4 weeks postpartum produced a marked decrease in tone of the abdominal muscles, having the appearance on the graph of an inverted visceromotor contraction.

DETERMINATION OF AFFERENT CONNECTIONS OF UTERUS WITH THE CORD

Series A—with minimum adequate stimuli. A mature non-pregnant female dog was prepared for the recording of the uterine visceromotor reflex by the sudden pressure method of stimulation in the manner described in the first experiment. The animal was then strapped in the prone position, and

the spinal cord was exposed by a laminectomy narrow enough to avoid laceration of the vessels but wide enough to gain access to the posterior dorsal roots, and reaching from the eighth thoracic to the sacrum. Care was taken to avoid touching the cord, and to procure effectual hæmostasis. The dura was then longitudinally incised in the midline. The animal was turned on its right side, and the pelvis was immobilized, and the left rectus was connected to the recording apparatus. The minimal adequate impulse for the uterine visceromotor reflex was determined (100 millimeters of mercury), and the reflex found to be normal. When the upper cut edge of the dura mater was seized and gently raised up, the fan-like distribution of the sensory fibers from the dorsal nerve roots to the cord was brought into prominence, and could be cut without touching the cord or the efferent root. By this technique, therefore starting with the cauda equina in successive order from below upward, the sensory roots were divided on the left side. Following each nerve section a minimal adequate stimulus was applied to the uterus, and the visceromotor reflex recorded.

Section of the sacral roots and lower lumbar roots produced no change in the strength of the response. After section of the second lumbar the reflex was diminished though still well marked. When the first lumbar root was divided, the reflex was abolished. That the motor side of the reflex arc was still active was shown by mechanical stimulation of the ventral root (Fig. 3).

The animal was then fixed upon its left side and the right rectus was attached to the recording lever. A minimal adequate stimulus to the uterus was followed by a visceromotor reflex 3 centimeters in depth. The right dorsal nerve roots were then cut

from above downward in order to determine the lower limit of the uterine afferent distribution to the cord. After section of the first lumbar the visceromotor reflex had suddenly diminished to 1 centimeter in depth. When the second lumbar had been divided, there was no response to uterine stimulation. Nevertheless stimulation of the intestine by traction on its mesentery produced a visceromotor contraction (Fig. 3).

Apparently the afferent fibers from the uterus in the dog enter the cord only by the first and second lumbar roots.¹

Series B—with increasing stimuli showing spread of impulses to adjacent segments through opposite roots
First stage. A mature non-pregnant dog was prepared for experiment in the manner previously described except that the gradual pressure method of stimulation was used in order that pressure could be readily increased. After laparotomy the animal was fixed upon its right side for recording and the left rectus was attached to the recording apparatus. A strong, sustained visceromotor contraction followed—after a 2 second latent period—dilatation of the uterus with a pressure of 160 millimeters of mercury. In successive order, then, from below upward commencing at the fourth lumbar the left dorsal roots were cut, and an intra-uterine pressure of 160 millimeters was applied after each, while the resulting visceromotor reflex recorded.

After the fourth, third, and second left lumbar were cut, the promptness of response was still the same, and the amount of the visceromotor contraction was undiminished. After the first lumbar was cut, however there was a sudden prolongation of the latent period from 2 seconds to 5 seconds, and the amount of the visceromotor reflex contraction was suddenly markedly diminished. The depth of contraction measured less than one-third of previous reflexes and the duration of increased tone was also cut down about two-thirds. Section of successive roots and stimulation up to 240 millimeters of mercury produced only slight and further delayed responses until after the tenth thoracic was cut no response could be elicited. Nevertheless, stimulation of the efferent root produced a strong contraction and presence of the knee jerk, and other tendon reflexes showed the animal to be still in good condition. (Graph III Fig. 3)

Second stage. Similar operation in another mature non-pregnant dog, except that the left dorsal roots were cut from above downward.

Strong uterine visceromotor reflexes were demonstrated and continued to be characteristic and uniform after the eleventh, twelfth, thirteenth thoracic and first lumbar were cut. Latent period in each case was short and equal. After the second lumbar was cut, latent period was suddenly prolonged by about 3 seconds. The contraction became atypical.

The author wishes to thank Professor John Tait of McGill University for his encouragement in the planning and pursuit of these experiments.

It was gradual and shallow in spite of powerful stimulation (over 240 millimeters of mercury).

After the third lumbar was cut, reflexes from the uterus were still present, but were very shallow and exhibited a similar prolongation in latent period.

Right dorsal roots were then cut because it seemed apparent that these atypical reflexes were not coming through the left dorsal roots, but must have been relayed across the cord through synapses with the right uterine afferent fibers. As expected, after this possible source of error had been eliminated, uterine dilatation no longer elicited a visceromotor response of any kind.

The cord was then stimulated at its cut end and found to be still very active. That other visceromotor reflexes, having their afferent roots above the cut segments, were still present, was ascertained by pulling on the stomach mesentery when a strong contraction of the rectus occurred (Graph IV Fig. 3).

To check these results many similar experiments were performed. Because of the severity and length of necessary operative trauma, and the tendency toward fatigue of reflexes, many experiments were inconclusive. However a series of ten successful experiments—six of the first stage and four of the second stage, in which the presence of other reflexes at the end showed the animal to be still reacting normally—agreed exactly with the above findings in respect to the localization of the sensory roots of the uterus by the exhibition of normal reflexes. Atypical reflexes with delayed latent period differed, however in the extent of their spread depending upon the intensity of stimulus, and the general condition of the animal. These delayed reflexes were demonstrated up to four segments cranial, and two segments caudad to the first and second lumbar inclusive.

Series C—with increasing stimuli and opposite roots cut
First stage. Similar operation on non-pregnant mature dog except that all right dorsal roots were cut before the experiment was begun on left visceromotor reflexes.

From below upward left dorsal roots of the fifth, fourth, third and second lumbar were cut, and characteristic visceromotor reflexes were elicited. After the first lumbar was divided visceromotor reflexes failed to appear in spite of eight successive well spaced stimulations by intra uterine pressure beginning at 160 millimeters of mercury and gradually increasing. The motor side of the reflex arc was then shown to be very active (Graph V, Fig. 4). This experiment was repeated in a recently pregnant dog in which the characteristic relaxation, instead of contraction, occurred in response to dilatation of the uterus. These reflexes were abolished after the first lumbar was cut.

Second stage. In a female non pregnant dog in which all right dorsal roots were cut, before the experiment was begun on the left visceromotor reflexes, the left roots were cut from above downward. The visceromotor reflexes were very strong until sud-

nerve roots were numbered two higher in the dog than in man required experimental proof before the clinical application was undertaken. It was conceived that this could be furnished by the experimental determination in the dog of the segments of the abdominal wall associated with afferent impulses from the fallopian tube, because in man this organ does not usually send sufficiently strong painful impulses to cause spread to segments adjacent to those receiving the afferent impulses and therefore its afferent supply by areas of hyperesthesia could be relied upon for comparison. eleventh and twelfth thoracic and first lumbar.

In this experiment the visceromotor reflex arc was interrupted on the motor side just lateral to the muscle instead of at the afferent root. By the same method of elimination as before it was determined that the first second and third lumbar nerves only carried the impulses from the fallopian tube to the rectus. From this experiment the hypothesis was found to be correct, and it was deduced that the uterine afferent roots in the human are the eleventh and twelfth thoracic (Fig. 5)

CLINICAL APPLICATION¹

CASE 1. Paravertebral block with novocain.

Mrs. F. G. was admitted to the Oregon City Hospital on May 3, 1932 at 9:00 a.m. having pains about every 10 minutes, with a history of six previous labors in each of which she had had prolonged first stage pains (with several remissions) and a rigid os. After several hours in hospital a remission of uterine activity occurred. At 4:30 a.m. May 5 pains recommenced, and by 6 o'clock, were strong, every 6 to 7 minutes. By rectal examination the cervix was found to be thick and closed and being pushed downward, without dilatation with each pain. By drawing a pin lightly over the abdomen in the longitudinal direction, from above downward and from below upward (Head's method) hyperalgesia was found to be confined to an area in the lower abdomen, the upper transverse boundary of which was one-third the distance from the umbilicus to the pubis, and the lower boundary of which was at Poupert's ligament, that is the eleventh and twelfth thoracic.

With the patient on her left side at 6:00 a.m., the eleventh and twelfth thoracic nerve roots, on both sides, were injected paravertebrally with 5 cubic centimeters of 1 per cent novocain (Pauchet's method). The patient ceased moaning with her uterine contraction. At 6:30 a.m., the uterus became

prominent and on palpation was found to be hard (in strong contraction) but the patient's expression remained unchanged. The uterine contraction lasted 30 seconds. Upon questioning, the patient said that she had felt a "numb sensation, but no pain." The area of hyperalgesia had disappeared and had given place to analgesia over the eleventh and twelfth thoracic segments. During the 3 hours following, twenty-one painless contractions were observed. No change after the sensory fibers were blocked, in the strength of contraction of the uterus could be appreciated by palpation nor was the frequency or duration of contraction affected. As could be expected from the small amount of novocain required, no toxic effects were observed and the rate and quality of the heart beats of mother and child showed no change. The patient went into another depression of uterine activity and since this occurred before the analgesia had worn off there was no return of pain. The cervix had thinned out considerably but was still rigid. The patient was sent home. She later contracted a general impetigo infection, on account of which reinjection was withheld (despite her request for same) when pain recommenced.

CASE 2. Paravertebral block with nupercaine.

Mrs. R. R. weight 360, gave a history of prolonged preliminary pains with her first labor. Due on July 4, 1932 she began to have slight irregular pains at noon on June 26th. By 4 p.m. the pains had become regular every 3½ minutes, lasting about a half a minute but the presenting part was still at the brim of the pelvis.

Hyperesthesia was found to be confined to the eleventh and twelfth thoracic segments. At 4:45 p.m. the eleventh and twelfth roots were injected paravertebrally each with 5 cubic centimeters of nupercaine, 1:1000. During the next hour and a half a record of 30 contractions was made, each lasting from one half to one minute. There was no pain, but the patient was conscious of each contraction, describing it as a numb sensation in the suprapubic region. As far as could be judged by palpation, there was no difference between the painless contractions and those that were observed before the paravertebral block. The areas of hyperalgesia were replaced exactly by analgesia. No significant change in rate or quality of maternal or fetal heart, or any toxic symptoms or signs could be ascertained. At 7 p.m. the patient was still having painless contractions. At 8:30 p.m. analgesia had disappeared. At 8:40 p.m. hyperalgesia was elicited over the eleventh and twelfth thoracic skin segments. By 9:03 p.m. the patient was again complaining of hard pains, seemingly more severe than heretofore. At 9:45 p.m. it was found that hyperesthesia had extended to include tenth, eleventh, and twelfth thoracic, and third and fourth lumbar. One hour later pains subsided. Since the patient was in the country reinjection when labor again started, was not attempted.

CASE 3. Paravertebral and caudal anesthesia in labor using novocain

¹These are Drs. Doctors Gray and Frank Mennet, and the nursing staff of the Oregon City Hospital for their co-operation.

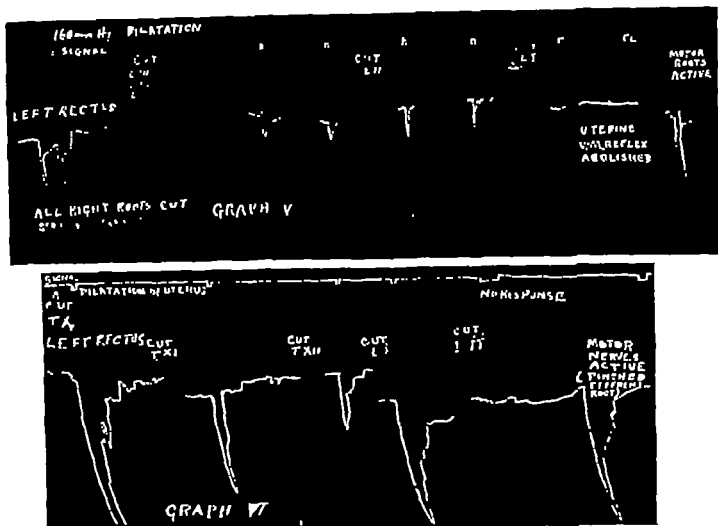


Fig. 4. To illustrate experiments Series C in which, after the opposite nerve roots were cut, no strong stimulus could produce reflexes above the first lumbar or below the second lumbar (Graphs V and VI)

A primipara, Mrs. W J V O, was admitted to the Oregon City Hospital at 5:15 a.m., May 30, having slight pains at irregular intervals. Rectal examination at 6 p.m. showed the cervix to be dilated to a diameter of 5 centimeters. Hyperesthesia was found definitely to correspond to Head's area, the eleventh and twelfth thoracic segments, and moderately increased tone was palpated in the lower abdomen corresponding to the area of hyperesthesia. The patient complained of a steady soreness or backache at the level of the top of the sacrum, chiefly over the left sacro-iliac joint, more severe with each pain. By 6:30, uterine contractions were strong every 3 to 5 minutes lasting for one and a half minutes, causing the patient to cry out loudly for relief. She wanted anything but ether (which had caused vomiting when given for a minor operation), and a prolonged gastric disturbance afterward) and willingly consented to regional block. 6:35 to 6:35 p.m., injection of both eleventh and twelfth thoracic nerve roots paravertebrally with 5 cubic centimeters novocain 1 per cent. 6:40 to 6:44 p.m., two strong uterine contractions palpated, but complete analgesia, except for pain in back which persisted as a soreness.

6:47 p.m., strong uterine contraction of 35 seconds duration, without crampy pains and the soreness in back "not as bad as it was." 6:51 to 7:03 p.m., five strong uterine contractions without cramp-like pain lasting between one, and one and a half minutes. Patient states she feels like going to sleep, as back ache is better. 7:05 to 7:15 p.m., six contractions with slight suprapubic cramp-like pain at onset, increasing in severity with each pain.

Hyperesthesia was found to be now present over the twelfth thoracic area whereas the eleventh was still analgesic. Apparently the twelfth root had been inadequately blocked. Rectal examination showed labor to be proceeding with cervix now 8 centimeters in diameter. Fetal heart was loud, rate 140. 7:15 to 7:45 p.m., analgesia in eleventh segment remained constant while contractions continued every 3 to 5 minutes with pain. 7:50 p.m., reinjection twelfth thoracic using adrenalin and novocain (mm. 1 to 5 c.cm.). 8:00 to 9:15 p.m., cramp-like pain abolished while strong contractions continued at 2 to 3 minute intervals, but pain (of stretching?) felt low down in the region of the symphysis pubis and in the back. 9:16 p.m., caudal block with 35 cubic centimeters of

novocain 1 per cent, with adrenalin, was followed by cessation of all pain. Uterine contractions then stopped. Analgesia had extended up to the level of the ninth thoracic segment and down the legs.¹ Cervix fully dilated. Patient vomited. Fetal heart strong, 148. 10:35 p.m., palpable strong contractions about one minute in duration, every 5 minutes with only an ache in left sacral region. 11:00 p.m. paravertebral analgesia had worn off and patient is complaining of cramp-like labor pains. Sodium amylal, 6 grains, was given. 12:30 to 1:40 a.m. pains every 3 minutes. Patient crying out for another nerve-blocking injection. 1:40 a.m. caudal block with 20 cubic centimeters novocain 1 per cent abolishing the stretching pains in the region of the symphysis pubis and back, but not affecting pains of contraction. No toxic symptoms appeared in either mother or child. 3:30 a.m. delivery was completed by low forceps, without causing pain and relaxation was so complete that there was not the slightest abrasion of the perineum. The baby was unusually prompt to stretch its arms and legs, to cry lustily. The placenta was expressed intact at 2:50 a.m. Total blood loss measured 6 ounces. The tone of the uterus remained good. Baby regained birth weight on fifth day. Involution of the uterus was normal.

CASE 4. Paravertebral block, novocain with epinephrine and caudal, nupercaine without epinephrine.

Mrs. J. W. a multipara at term was admitted to the Oregon City Hospital, at 9:35 p.m. June 28, 1932, with slight irregular labor pains. By 8:30 p.m. she was complaining of strong pains, at 4 to 5 minute intervals, lasting 20 to 30 seconds. Rectal examination showed the cervix to be $\frac{3}{4}$ centimeter thick and 3 centimeters in diameter. Hyperesthesia was elicited over the eleventh and twelfth thoracic areas. At 9:00 p.m. the eleventh and twelfth roots were injected paravertebrally each with 3 cubic centimeters of 1 per cent novocain, plus epinephrine, and the pain of uterine contraction was no longer felt. Hyperesthesia had disappeared and given place to analgesia over the same area. Blood pressure was 140/80. Uterine contractions were so strong that it was presumed that labor would be completed within 4 hours and caudal block was therefore given at 9:40 using 20 cubic centimeters nupercaine 1/500. Patient was now completely comfortable while at intervals of $\frac{3}{4}$ to 5 minutes, the uterus went into strong contraction, rising up into a round hard ball. Between 9:45 and 11:30 p.m. 35 such contractions were observed—lasting from $\frac{3}{4}$ to $1\frac{1}{2}$ minutes, becoming progressively longer and stronger but without the slightest sensation of pain. At 11:30 p.m. examination showed that labor was progressing, the head being much lower and the cervix thinned out and dilated to 8 centimeters in diameter. The fetal heart was heard loudly in the right flank at 160. From 11:30 p.m. to 12:30 a.m. the

patient continued to be free from pain, but had a numb feeling of tightness in the lower abdomen, while contractions proceeded every 3 minutes. At 11:45 p.m. hyperesthesia was found to be returning to the eleventh and twelfth thoracic areas, but analgesia was still present to deep pinching. Analgesia was still present in the perineum showing caudal anesthesia to be still active. At 12:00 p.m. "show" appeared (with dilatation of the cervix) and the patient was instructed to bear down with contractions. At 12:33 a.m. $\frac{3}{4}$ hours after paravertebral injection, the patient began to have pain with contractions, which were of the same character and frequency as before. At 12:50 a.m. there was some "bulging" and the membranes were ruptured. The presentation was persistent occiput posterior. At 1:30 a.m. under light ether anesthesia, as the pain had become severe, paravertebral block was attempted, with 5 cubic centimeters of $\frac{1}{4}$ of 1 per cent novocain. On coming out of anesthesia, patient still complained of pains, and it was found that the perineal analgesia had disappeared. Instead of repeating the caudal block, in this case, ether was given while the baby was delivered by Scanzoni rotation at 2:10 a.m. The baby cried well spontaneously. The placenta was delivered intact at 2:30 a.m. Blood loss was not abnormal. The fundus remained firm. No sedative of any kind was used until after the effect of the regional anesthetic had worn off. No toxic effects were observed.

CASE 5. Paravertebral block with nupercaine 1:1000 and epinephrine, and caudal block with nupercaine 1:500 and epinephrine.

Mrs. R. B. age 35 was admitted to the Oregon City Hospital on June 21, 1932, with pre-eclamptic toxemia of 3 months duration, becoming severe during the preceding week. She gave a history of chronic invalidism and difficult labors. After a week of medical treatment her blood pressure was 182/114, pulse 118, haemoglobin 50 per cent, albumen 2 plus, phenolsulphonphthalein total output 23 per cent, and toxic symptoms became severe. On July 1, 9:30 a.m. caudal block with 20 cubic centimeters of nupercaine 1:500 plus epinephrine was given, and a Voorhees bag painlessly inserted. Patient continued to be comfortable except for an occasional slight contraction-pain, until 3 p.m. when she began to complain of regular pains. At 3:30 p.m. hyperesthesia was found in the eleventh and twelfth thoracic areas, and analgesia was still present in the perineum from caudal block of 6 hours previous. At 4 p.m. paravertebral injection of eleventh and twelfth thoracic roots on each side (using 5 cubic centimeters of nupercaine 1:1,000 to which had been added epinephrine) was done. The cramp-like pain of uterine contraction was immediately abolished. The bag was expelled at 4:15 p.m. At 4:40 p.m. labor was progressing satisfactorily with painless contractions every 2 to 4 minutes. Cervix was 8 centimeters dilated.

As the analgesia in the perineum disappeared stretching pains were felt low down in the region

¹ Much difference along the structural lines in higher nerve roots was prevented in subsequent operations by using only 20 cubic centimeters for caudal analgesia. The possibility of variability in anesthesia of the birth canal could be avoided by blocking the individual sacral roots should the experimental determination of these lesions be accomplished.

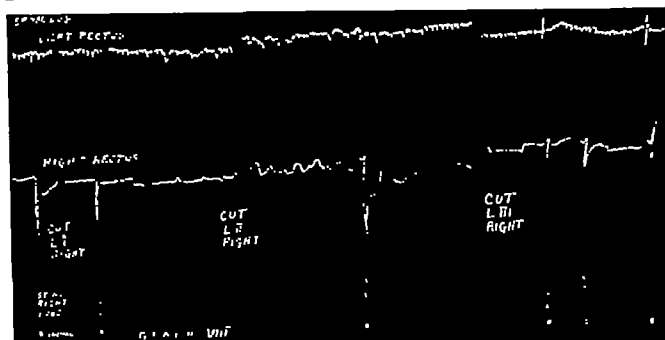
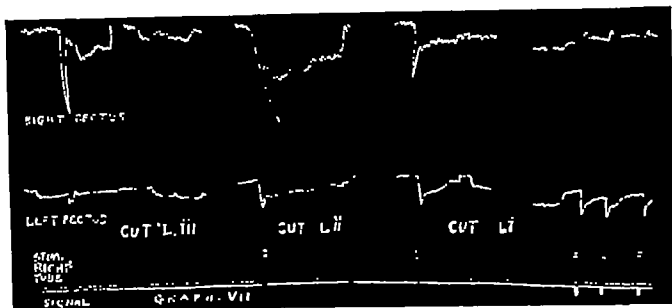


Fig. 5 To illustrate the experiments to determine the segments of the abdominal musculature involved (by hyper-tonicity) in stimulation of the right fallopian tube, i.e. Graph VII, the upper limit reached after the first lumbar was cut, Graph VIII the lower limit reached after the third lumbar was cut. The tonus of the left rectus is simultaneously recorded above as a control.

of the symphysis pubis becoming severe enough to require repetition of caudal block at 6.45 20 cubic centimeters of nupercaine 1:1,000 and novocain 1 per cent, equal parts. After this the only remaining discomfort was a feeling of fullness in the bladder aggravated with each contraction. This was relieved by catheterization of about 16 ounces. Spontaneous delivery occurred at 7.35 p.m. without the mother being aware of the birth. The baby cried promptly and well. The placenta was expressed at 7.48 p.m. One cotyledon was missing and was removed manually without pain. Blood loss was unusually slight. The fundus remained firm. There was no pain of contraction felt at any time during the labor after

the paravertebral block. No sedative was given after the preliminary hypodermic preceding bag induction. Mother's pulse, palpated steadily from caudal block to delivery remained steady at 104, and no toxic effects of anæsthetic were apparent at any time during the labor.

CONCLUSIONS

1. The pains of labor are made up of two components, namely (a) that due to uterine contraction which is transmitted by afferent fibers through the eleventh and twelfth thoracic roots, (b) that due to stretching of the

birth canal, which is transmitted through certain undetermined sacral roots

3. Paravertebral block of eleventh and twelfth thoracic roots will abolish the pain of uterine contraction for a length of time varying with the type of anæsthetic used without appreciably affecting the tone of the uterus or the degree frequency or duration of contractions.

3. The pain of dilatation of the birth canal may be abolished by caudal block with about 20 cubic centimeters of novocain 1 per cent or nupercaine 1:500 for varying lengths of time dependent on the type of anæsthetic used without depressing the tone or contractions of the uterus.

4. While the eleventh and twelfth thoracic roots are blocked there is no hyperæsthesia whereas in the absence of such anæsthesia the painful impulses may spread in the cord to produce hyperæsthesia in other segments adjacent to those receiving the painful impulses.

5. The combination of paravertebral and caudal anæsthesia in a safe dosage is feasible in labor and the block, which may last as long as 8 hours, may be safely repeated.

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THE CHEMICAL COMPOSITION OF AMNIOTIC FLUID

A COMPARATIVE STUDY OF HUMAN AMNIOTIC FLUID AND MATERNAL BLOOD¹

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MAKEPEACE and his co-workers, in a recent communication, make the following statement "The source and nature of the amniotic fluid, its rate of formation, the mode of reabsorption, if reabsorption occurs, the factors which govern its volume, are all matters of conjecture concerning which but little data exist. Even the chemical composition has been studied in detail by only one modern investigator. This interesting and important fluid is not mentioned in most textbooks of physiology and biochemistry." Various conceptions of its origin attribute it to fetal urine, to transudation from maternal blood, secretion by the amniotic epithelium and to a combination of several factors. Zangemeister and Meissl, and Makepeace, Fremont-Smith, Dailey and Carroll, are of the opinion that although the amniotic fluid may originate as a dialysate in equilibrium with the maternal and fetal body fluids, as pregnancy advances the fluid becomes progressively more diluted by fetal urine. On the basis of available experimental data, this hypothesis would appear to be the most logical. However, in view of the relative paucity of material, no definite statement can be made in this connection at the present time.

The present investigation consists of determinations of the protein, non protein nitrogen, uric acid, sugar, calcium and phosphorus concentrations of amniotic fluid and maternal blood obtained simultaneously from 36 essentially normal patients. The amniotic fluid was obtained by one of three methods. In a few instances, during the seventh to the ninth months of pregnancy, it was obtained by direct puncture of the amniotic sac through the abdominal and uterine walls, a long needle and a syringe being used. In the great majority of cases at term, the unruptured membranes were punctured by a needle attached to a syringe either when they presented at the vulva or when the uterus was opened at

caesarean section. Cloudy fluids were centrifuged, the chemical determinations being made upon the clear, supernatant fluid. Whole blood, obtained by venipuncture, was used for the estimation of non protein nitrogen, uric acid and sugar and serum for the estimation of total protein, calcium and inorganic phosphorus. Total protein was determined by a micro-Kjeldahl method, direct nesslerization being employed (Hawk), calcium by the Clark Collip modification of the Kramer Tisdall procedure, inorganic phosphorus by the method of Youngberg, non protein nitrogen by the method of Folin and Wu, uric acid by the method of Benedict, and sugar by the method of Benedict.

PROTEIN

The protein content of the maternal blood serum varied from 4.07 to 7.5 grams per 100 cubic centimeters, averaging 6.06 grams. Clinically demonstrable edema was not present in any case and the protein concentration bore no apparent relation to the duration of pregnancy. Makepeace and his associates obtained values at term, ranging from 5.3 to 6.8 grams, with an average of 6.1 grams per 100 cubic centimeters. The protein content of blood serum during pregnancy thus appears to be slightly lower than that of normal, non-pregnant women which averages 7 grams per 100 cubic centimeters or slightly higher. These findings coincide with those of most observers. Oard and Peters, Coetzee, and Plass and Bogert found that the serum protein concentration fell to an average of about 6.2 per cent during the first 6 months of pregnancy, gradually rising to reach 6.9 per cent at term. Oberst and Plass later reported an average of 6.9 per cent in early and 6.4 per cent in late pregnancy.

The protein content of the amniotic fluid in this series varied from 0 to 1.5 per cent, averaging 0.53 per cent. This figure corres-

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ponds exactly with that reported by Tausig but is higher than the values obtained by Zangemeister and Meissl and Makepeace who report average values of 0.22 and 0.23 per cent respectively

NON-PROTEIN NITROGEN

The non-protein nitrogen content of the maternal blood serum ranged from 13.76 to 36 milligrams per 100 cubic centimeters, averaging 23.98 milligrams. Many investigators including Caldwell and Lyle, Harding, Allin and Van Wyck, Killian and Sherwin and Krebs and Briggs, have found that the non-protein nitrogen concentration of the blood falls during the later months of pregnancy the reduction occurring chiefly in the urea fraction. Harding in a review of the subject, states that he believes this phenomenon to be due to reduced catabolism of protein during the period when nitrogen is being withdrawn from the mother to supply the increasing demands of the fetus. In a series of 200 other women in the last 3 months of normal pregnancy we have obtained values for blood non-protein nitrogen varying from 17.96 to 36.58 milligrams per 100 cubic centimeters. 83 per cent of these ranged from 17.96 to 20 milligrams. 63.6 per cent from 20.01 to 25 milligrams. 26.6 per cent from 25.01 to 35 milligrams and 2.6 per cent were above 35 milligrams per 100 cubic centimeters. In a series of 19 normal pregnant women at term, Makepeace and his co-workers observed values varying between 19 and 32 milligrams averaging 24 milligrams per 100 cubic centimeters.

The latter observers in a study of the non-protein nitrogen content of the amniotic fluid in 33 cases, found it to range from 18 to 39 milligrams per 100 cubic centimeters, averaging about 27 milligrams. The duration of pregnancy varying from 2 to 9 months appeared to have no relation to the non-protein nitrogen content of the amniotic fluid. The amniotic fluid values were higher than those of the blood in 16 instances and lower in 12 there being no definite correlation between the two. In the present series of 36 cases, the amniotic fluid non-protein nitrogen content ranged from 13.6 to 37.5 milligrams per

100 cubic centimeters, averaging 24.25 milligrams, being higher than the blood non-protein nitrogen in 15 and lower in 21 instances. Williams and Barger, in a series of 11 normal patients, obtained figures of from 16.22 to 35.45 milligrams, averaging 27.03 milligrams, while Zangemeister and Meissl report an average of 23 milligrams as compared with an average maternal blood non-protein nitrogen content of 22 milligrams per 100 cubic centimeters.

URIC ACID

Bunker and Mundell, Harding, Allin and Van Wyck and Slemons and Bogert have reported observations which appear to indicate that the uric acid content of the blood begins to rise in the late months of pregnancy and continues to increase until the termination of labor. Most observers, however, have failed to substantiate these findings and the general opinion is that the blood uric acid remains within essentially normal limits during pregnancy. Uric acid determinations in 35 cases of the present series yielded values ranging from 1.6 to 4.6 milligrams per 100 cubic centimeters averaging 3.05 milligrams, the normal limits by the method employed being 2 to 4 milligrams.

Uyeno in 1919 demonstrated the presence of uric acid in human amniotic fluid but was unable accurately to estimate the amount. Williams and Barger in a study of 11 normal cases report values of 1.93 to 7.73 milligrams, the average being 4.51 milligrams per 100 cubic centimeters. There seemed to be a tendency toward higher values in the later months of pregnancy. In 5 instances simultaneous determinations of uric acid in maternal blood and amniotic fluid revealed consistently higher values in the latter the average being 5.29 milligrams for the fluid and 3.60 milligrams for the blood. The Folin method was employed by these investigators. In the data presented by Tausig the uric acid content of the amniotic fluid is given as 10 milligrams per 100 cubic centimeters as contrasted with a fetal blood concentration of 3.2 milligrams per cent. In the present series the uric acid content of the fluid ranged from 2.06 to 8.96 milligrams, averaging 4.54 milligrams per 100 cubic centimeters. There was no apparent

correlation between the maternal blood and amniotic fluid in this respect, the values for the latter exceeding those for the former in 31 instances

SUGAR

There seems little doubt that pregnancy is associated with some alteration in carbohydrate metabolism as evidenced by the relatively frequent occurrence of glycosuria and decreased glucose tolerance. However, the great majority of observers, including Hellmuth, Shrokaue, and Krebs and Briggs, report normal values for blood sugar during pregnancy. Occasional reports of low and high blood sugar concentrations are encountered in the literature. In our experience there is a distinct tendency toward a low normal or slightly subnormal blood sugar level which becomes more pronounced as the pregnancy progresses. In a group of 200 uncomplicated cases the blood sugar concentration ranged from 46 to 100 milligrams per 100 cubic centimeters (normal limits by the method employed 60 to 100 milligrams), 13.3 per cent were between 46 and 60 milligrams, 65.3 per cent 60.1 to 80 milligrams, 17.3 per cent 80.1 to 90 milligrams and 4.1 per cent 90.1 to 100 milligrams per 100 cubic centimeters. In the present series the figures varied from 48 to 108 milligrams, averaging 84 milligrams in 29 uncomplicated cases, 6 additional patients with mild diabetes mellitus having blood sugars of 109 to 140 milligrams per 100 cubic centimeters.

Williams and Bagen found the sugar content of amniotic fluid to vary from 0 to 35 milligrams per 100 cubic centimeters, averaging 19.6 milligrams in 11 normal cases. Makepeace and his associates observed values ranging from 11 to 86 milligrams, averaging 42 milligrams in the early months of pregnancy and from 11 to 62 milligrams, averaging 33 milligrams, at term. At about the third or fourth month the average sugar content was 58 milligrams per 100 cubic centimeters. Similar observations are reported by Mohs, who found the average value at term to be 26.5 milligrams per 100 cubic centimeters, being higher in the earlier months and decreasing as the weight of the fetus increases. The findings reported by Makepeace were obtained by the

Folin method, which yields values from 12 to 20 milligrams higher than those given by the Benedict method which was employed in the present study. In 36 cases the sugar content of the amniotic fluid ranged from 0 to 59 milligrams averaging 19 milligrams per 100 cubic centimeters. Reference to the accompanying table clearly indicates the absence of any correlation between the sugar content of this fluid and that of the maternal blood. For example, in Cases 34 and 35, with blood sugars of 140 and 135 milligrams, respectively, the amniotic fluid sugar concentrations were 19 and 9 milligrams per cent whereas in Cases 6 and 9, with blood sugars of from 71 to 96 milligrams, the amniotic fluid sugar ranged from 46 to 59 milligrams per 100 cubic centimeters. That glucose constitutes a large proportion of the reducing substance present in the fluid is demonstrated by the work of Makepeace and his co-workers.

CALCIUM

Most observers report a decrease in the level of serum calcium during pregnancy, beginning in the early months and becoming more marked in the later months. Deschamps found that during the first 9 lunar months of gestation the serum calcium remains within normal limits but that in the last month it is near the inferior limit of normal or slightly subnormal. Widdows noted a low calcium level during pregnancy, with a rise following delivery and in early lactation. Mazzocco observed the average serum calcium in 29 pregnant women to be 8.77 milligrams per 100 cubic centimeters as compared to 9.19 in 19 non-pregnant women. Cantarow, Montgomery and Bolton found that during the course of normal pregnancy and early labor there is a gradual diminution in the serum calcium level from an average value of 10.61 milligrams in the early months to 9.45 milligrams per 100 cubic centimeters at term. Oberst and Plass report the following observations normal, non-pregnant women, average serum calcium 10.4 milligrams, early pregnancy, 10.4 milligrams, late pregnancy, 9.5 milligrams per 100 cubic centimeters. Other observers among them Denis and King, and Underhill and Dimick, believe that no change in serum cal

cium occurs during pregnancy. In the present study the serum calcium concentration in 31 cases varied from 8.2 milligrams to 12.58 milligrams per 100 cubic centimeters, averaging 9.82 milligrams, values which are slightly above those obtained by us in previously observed groups of cases.

Salvesen and Linder in 1923 noted a parallelism between changes of protein and calcium in sera and transudates from patients with nephritis and heart failure. In some cases of advanced renal failure there was also observed to be a decrease in serum calcium proportional to the increase in inorganic phosphorus which was present in these cases. Later Peters and Elseron developed the following mathematical equation to express the relationship between serum calcium, protein and inorganic phosphorus

$$\text{Ca} = 7 - 0.255 \text{ P} + 0.556 \text{ protein}$$

According to these authors the serum calcium concentration varies directly with that of protein and inversely with that of inorganic phosphorus in the absence of any primary disturbance of calcium phosphate metabolism. Similar observations were made by Cantarow in a study of 14 patients with advanced renal failure. Studies by Greenwald Stearns and Knowlton and Oberst and Plass, however indicate that this mathematical expression cannot be applied in all cases, particularly in conditions other than renal disease. The latter investigators studying a large group of pregnant women state that whereas there is a significant correlation between the serum protein and the serum calcium concentrations in non-pregnant and puerperal women this relationship is completely lost in late pregnancy and parturition when the protein range is considerably widened. These observations are supported by our data in the present series which show no such definite correlation between these three factors as was previously seen in patients with renal failure.

There are comparatively few data available regarding the calcium content of amniotic fluid. Merritt and Bauer in 7 cases, found values ranging from 5.4 to 8.8 milligrams per 100 cubic centimeters, averaging 6.59 milligrams, with serum calcium concentrations of 8.07 to 9.58 milligrams, averaging 8.59 milli-

grams per 100 cubic centimeters. Makepeace and his associates in 6 cases, some of which were apparently the same as those reported by Merritt and Bauer obtained figures for amniotic fluid calcium ranging from 5.3 to 8.8 milligrams averaging 7.1 milligrams per 100 cubic centimeters. In the present study calcium determinations were made on the amniotic fluid in 32 instances the values obtained ranged from 3.26 milligrams to 7.84 milligrams per 100 cubic centimeters averaging 5.46 milligrams being definitely lower than those previously reported. There was no apparent relationship between the calcium concentration in the fluid and its protein and inorganic phosphorus content.

INORGANIC PHOSPHORUS

Normal pregnancy is associated with no significant alteration in the level of serum inorganic phosphorus. Thus, Oberst and Plass report average values of 4.1 milligrams and 3.8 milligrams in the early and late months respectively as compared with 4.0 milligrams per 100 cubic centimeters in normal non-pregnant women. In the present series the serum inorganic phosphorus varied from 3.5 milligrams to 5.7 milligrams per 100 cubic centimeters averaging 4.3 milligrams. The phosphorus content of the amniotic fluid ranged from 1.2 milligrams to 5.4 milligrams per 100 cubic centimeters, averaging 3.1 milligrams. Merritt and Bauer in 2 cases obtained values of 0.94 milligrams and 1.2 milligrams per 100 cubic centimeters. As stated previously, neither in the blood serum or in the amniotic fluid was there any demonstrable correlation between the concentrations of calcium, protein and inorganic phosphorus. Particularly noteworthy is the fact that the phosphorus content of the amniotic fluid was apparently independent of that of the blood serum to a remarkable degree, being actually greater than the latter in 4 instances and practically identical with it in 6 others, the ratio between the two values in the remaining cases being extremely variable.

OBSERVATIONS FROM STUDY

This study was not undertaken with the intention of drawing any deduction regarding

TABLE I.—AMNIOTIC FLUID AND MATERNAL BLOOD SERUM

| Case | Month | Protein gm. per cent | | NPN mgm. per cent | | Uric acid mgm. per cent | | Sugar mgm. per cent | | Calcium mgm. per cent | | Phosphorus mgm. per cent | |
|---------|-------|-------------------------|-------|----------------------|-------|----------------------------|-------|------------------------|-------|--------------------------|-------|-----------------------------|-------|
| | | Blood | Fluid | Blood | Fluid | Blood | Fluid | Blood | Fluid | Blood | Fluid | Blood | Fluid |
| 9 | 7 | 5.47 | 0.30 | 18.4 | 15.3 | 1.65 | 2.00 | 79 | 48 | | 5.0 | 4.5 | 1.3 |
| 18 | 7 | 5.31 | 0.53 | 13.76 | 14.85 | 2.05 | 2.33 | 73 | 37 | 10.0 | 5.7 | 4.6 | 1.8 |
| 16 | 7 | 6.12 | 0.61 | 21.5 | 20.1 | 3.4 | 4.12 | 83 | 31 | 9.79 | 4.3 | 3.9 | 1.0 |
| 19 | 7 | 5.09 | 0.67 | 23.37 | 27.5 | 3.04 | 4.16 | 65 | 11 | 9.7 | 3.78 | 4.0 | 3.8 |
| 2 | 8 | 6.2 | 1.5 | 15.2 | 13.8 | .8 | 2.22 | 87 | 21 | | | 4.3 | 2.1 |
| 3 | 8 | 6.2 | 0.75 | 26.0 | 23.6 | 2.9 | 3.7 | 59 | 7 | 9.0 | 5.54 | 3.6 | 1.6 |
| 6 | 8 | 6.25 | 0.81 | 15.2 | 18.56 | 2.17 | 3.65 | 82 | 59 | 8.0 | 5.7 | 4.4 | 1.6 |
| 25 | 8 | 5.65 | 0.19 | 24.38 | 23.71 | 3.23 | 3.36 | 26 | 24 | 11.57 | 5.0 | 4.8 | 5.0 |
| 31 | 8 | 5.29 | 0.73 | 23.58 | 29.85 | 2.64 | 3.52 | 58 | 16 | 12.58 | 4.16 | 3.4 | 4.7 |
| 1 | 9 | 5.3 | 0.77 | 20.5 | 29.0 | 2.24 | 2.54 | 106 | 0 | 8.77 | 5.52 | 4.6 | 2.2 |
| 4 | 9 | 5.3 | 0.0 | 27.8 | 29.4 | 2.27 | 4.76 | 83 | 0 | 9.59 | 5.31 | 4.5 | 3.3 |
| 5 | 9 | 6.57 | 0.68 | | | | | | | | | | |
| 7 | 9 | 6.87 | 0.48 | 26.08 | 30.03 | 2.68 | 3.98 | 96 | 48 | | | | |
| 8 | 9 | 7.5 | 0.48 | 20.54 | 13.6 | 2.71 | 2.66 | 71 | 46 | | | 4.4 | 1.6 |
| 10 | 9 | 5.03 | 0.58 | 19.10 | 14.07 | 2.18 | 2.8 | 74 | 22 | 11.1 | 7.4 | 4.0 | 1.2 |
| 11 | 9 | 5.1 | 0.50 | 21.13 | 18.75 | 2.24 | 2.8 | 81 | 23 | 5.5 | 5.1 | 1.6 | |
| 13 | 9 | | | 20.47 | 18.01 | 3.8 | 6.4 | 81 | 23 | 9.4 | 5.85 | 4.3 | 2.1 |
| 14 | 9 | | | | 27.27 | | 8.96 | | 19 | | | | |
| 15 | 9 | 6.8 | 0.75 | 29.6 | 27.7 | 4.3 | 7.3 | 74 | 7 | 8.4 | 3.26 | 4.2 | 1.8 |
| 17 | 9 | 5.26 | 0.72 | 21.2 | 16.5 | 4.6 | 6.66 | 84 | 24 | 9.52 | 4.69 | 3.5 | 2.4 |
| 18 | 9 | 5.93 | .55 | 27.77 | 28.57 | 3.04 | 5.26 | 73 | 3 | 8.2 | 5.7 | 5.5 | 5.3 |
| 20 | 9 | 7.06 | 0.49 | 6.78 | 28.3 | 3.12 | 4.24 | 120 | 11 | 10.4 | 4.52 | 3.6 | 3.6 |
| 21 | 9 | 5.15 | 0.47 | 27.81 | 31.74 | 4.1 | 5.28 | 126 | 13 | 8.5 | 5.23 | 4.6 | 4.5 |
| 22 | 9 | 6.64 | 0.33 | 28.20 | 26.08 | 4.28 | 5.64 | 94 | 25 | 10.8 | 5.2 | 4.0 | 2.8 |
| 23 | 9 | 5.79 | 0.30 | 3.62 | 23.71 | 3.04 | 3.2 | 106 | 26 | 11.02 | 6.36 | 5.3 | 4.2 |
| 24 | 9 | 5.36 | 0.39 | 30.15 | 22.24 | 3.96 | 4.16 | 82 | 2 | 11.6 | 7.24 | 4.5 | 2.5 |
| 26 | 9 | 5.37 | 0.23 | 24.09 | 23.81 | 3.0 | 3.41 | 58 | 9 | 9.59 | 5.3 | 4.0 | 4.7 |
| 27 | 9 | 5.34 | 0.39 | 26.08 | 28.16 | 3.2 | 3.56 | 102 | 18 | 10.45 | 7.48 | 5.7 | 5.4 |
| 28 | 9 | 5.77 | 0.24 | 21.76 | 24.28 | 4.23 | 7.6 | 83 | 18 | 9.88 | 3.92 | 4.5 | 4.7 |
| 29 | 9 | 6.79 | 0.79 | 24.19 | 23.20 | 4.3 | 8.64 | 99 | 16 | 9.6 | 5.18 | 7.0 | 3.3 |
| 30 | 9 | 5.68 | 0.46 | 21.43 | 19.54 | .15 | 2.44 | 101 | 26 | 10.12 | 6.07 | 4.8 | 3.0 |
| 32 | 9 | 6.36 | 0.59 | 20.81 | 18.74 | 2.0 | 2.6 | 78 | 17 | 9.61 | 7.28 | 4.9 | 3.7 |
| 33 | 9 | 6.51 | 0.19 | 21.07 | 22.54 | 2.76 | 2.44 | 90 | 8 | 10.3 | 6.06 | 4.2 | 3.4 |
| 34 | 9 | 4.07 | 0.68 | 26.9 | 31.74 | 3.48 | 6.72 | 120 | 19 | 11.2 | 4.2 | 4 | 2.5 |
| 35 | 9 | | | 9.86 | 21.3 | 1.6 | 4.80 | 125 | 9 | 11.0 | 6.07 | 5.1 | 2.9 |
| 36 | 9 | 4.16 | 0.22 | 25.45 | 22.81 | 2.78 | 3.16 | 48 | 7 | 11.7 | 5.28 | 4.6 | 4.8 |
| Average | | 6.06 | 0.53 | 22.65 | 24.75 | 3.05 | 4.54 | 84 | 19 | 9.82 | 5.46 | 4.3 | 3.1 |

the essential nature or mechanism of formation of the amniotic fluid but certain observations may be made on the basis of the data obtained

✓ One conclusion is apparently justified, namely, that, as believed by Zangemeister and Meissl and by Makepeace and his associates, the amniotic fluid is not, at least at

TABLE II

| | Amniotic fluid | Cerebrospinal fluid | Transudates | Maternal blood |
|------------|----------------|---------------------|-------------|----------------|
| Proteins | 0-300 | 1-40 | 100-1000 | 4070-13000 |
| NTN | 13.0-27.5 | 2-30 | 20-40 | 3.7-46 |
| Uric Acid* | 0-8 g | 1-1.0 | — | 6-6.6 |
| Sugar* | 0-20 | 40-60 | 30-90 | 45-60 |
| Calcium | 3.2-7.8 | 5-5.5 | 1-5 | 8.1-11.5 |
| Phosphorus | 2-3.4 | 1-1 | — | 2.3-3.7 |

*All values expressed in milligrams per 100 cubic centimeters.
†Determinations made upon blood serum.

term a simple protein poor dialysate in equilibrium with maternal or fetal blood plasma. These authors based their conclusions chiefly upon differences in freezing point and chloride content and consider the amniotic fluid at term to be a mixture of fetal urine and what was originally a dialysate of maternal or fetal blood plasma. It is interesting to compare the chemical composition of the amniotic fluid with body fluids believed to represent filtrates or dialysates of the blood plasma, i.e. the cerebrospinal fluid and transudates in the subcutaneous tissue and the pleural and peritoneal spaces.

The protein content of such fluids is usually very low ranging from 15 to 45 milligrams in the case of normal cerebrospinal fluid and from 0.1 to 1 gram per 100 cubic centimeters in pleural and peritoneal transudates. The values obtained for amniotic fluid are perfectly compatible with the conception of its origin as a dialysate or transudate. It is difficult, on this basis, however to account for the rather frequent occurrence of higher concentrations of non-protein nitrogen in the amniotic fluid than in the blood. Similar observations are made at times on subcutaneous pleural and peritoneal transudates but not nearly so commonly. It may be that analyses of fetal blood and urine will throw some light upon this interesting finding. Perhaps the most important, and certainly the most consistent difference between the amniotic fluid and transudates and dialysates is its relatively high uric acid content, which was found to exceed that of the maternal blood in 31 of the 35 cases examined. It is of interest to note that the uric acid content of six samples of fetal blood ranged from 2.4 milligrams to 7.2

milligrams per 100 cubic centimeters, being higher than that of maternal blood in each instance. This observation may have some bearing on the amniotic fluid uric acid concentration although contamination by fetal urine may conceivably be a factor of importance. The sugar content of the fluid (0 to 50 milligrams) too differs greatly from that of cerebrospinal fluid (40 to 60 milligrams) and transudates (50 to 90 milligrams). The calcium content of the amniotic fluid varies within wider limits (3.2 to 7.8 milligrams) and the average concentration (5.46 milligrams) is higher than in the case of other protein poor body fluids, the calcium content of which apparently corresponds to the diffusible fraction of serum calcium (4.5 to 5.5 milligrams) any increase in protein content being accompanied by an increase in calcium. A similar discrepancy exists in connection with the inorganic phosphorus concentration which varying from 1.2 to 5.4 milligrams per 100 cubic centimeters, exceeded that of the maternal serum in 4 cases. The phosphorus content of cerebrospinal fluid and of most transudates ranges from 1 to 2 milligrams representing from 35 to 50 per cent of the serum inorganic phosphorus concentration. These data while they throw no light upon the essential nature and mechanism of formation of amniotic fluid indicate rather definitely that it cannot be regarded as a pure dialysate of maternal nor perhaps of fetal blood plasma. The possibility that it represents, in part contamination by fetal urine as believed by Makepeace and by Zangemeister and Meissl, cannot be denied on the basis of these observations.

SUMMARY

1. Chemical studies were made of amniotic fluid and maternal blood obtained simultaneously from 36 women in the seventh to the ninth months of normal pregnancy.

2. The protein content of the maternal serum ranged from 4.07 grams to 7.5 grams per 100 cubic centimeters. That of the amniotic fluid varied from 0 to 1.5 grams, averaging 0.53 gram per 100 cubic centimeters.

3. The non-protein nitrogen content of the maternal blood ranged from 13.76 milligrams to 36 milligrams, averaging 23.98 milligrams

per cent, being definitely lower than reported values for normal non pregnant women. The non protein nitrogen concentration of the amniotic fluid varied from 13.6 milligrams to 37.5 milligrams averaging 24.25 milligrams, being higher than the corresponding maternal blood values in 15 and lower in 20 instances.

4. The uric acid content of the maternal blood ranged from 1.6 milligrams to 4.6 milligrams, averaging 3.05 milligrams per 100 cubic centimeters. That of the amniotic fluid varied from 2.06 milligrams to 8.96 milligrams averaging 4.54 milligrams per 100 cubic centimeters and exceeding the maternal blood uric acid concentration in 31 cases.

5. The blood sugar concentration ranged from 48 milligrams to 108 milligrams averaging 84 milligrams per 100 cubic centimeters (Benedict method, normal range 60 to 100 milligrams per cent.) The sugar content of the amniotic fluid varied from 0 to 59 milligrams averaging 19 milligrams per cent.

6. The calcium content of the maternal serum ranged from 8.2 milligrams to 12.5 milligrams averaging 9.82 milligrams per 100 cubic centimeters, that of the amniotic fluid varied from 3.26 milligrams to 7.84 milligrams per cent, averaging 5.46 milligrams.

7. The inorganic phosphorus content of the maternal serum ranged from 3.5 milligrams to 5.7 milligrams averaging 4.3 milligrams per 100 cubic centimeters. The values for amniotic fluid phosphorus varied from 1.2 milligrams to 5.4 milligrams, averaging 3.1 milligrams per cubic centimeter and exceeding the serum phosphorus concentration in 4 instances.

8. These data are compared with corresponding observations on cerebrospinal fluid and transudates. It is believed that the amniotic fluid cannot be regarded as a pure dialysate of maternal blood plasma.

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NON-SPECIFIC GRANULOMA OF THE GASTRO-INTESTINAL TRACT

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NON SPECIFIC granulomata are chronic inflammatory, tumor like masses which may involve any portion of the gastro-intestinal tract. These generally are non-circumscribed infiltrations extending throughout several inches of the enteric wall. Some of them are fairly well circumscribed and involve only a portion of the circumference. These masses strongly suggest cancer or tuberculosis and the presence of mesenteric adenopathy further tends to confirm this suspicion.

It is noteworthy that a paper by Braun, in 1909, served to call attention to non specific inflammatory tumors, and furnished the emphasis to further investigation along this line. Practically all of the literature dates from the publication of his article.

PATHOLOGY

The vast majority of these non-specific tumor like masses have been reported as occurring in the colon, though in a few instances they have been found in the small intestine, the stomach, the mesentery, with secondary involvement of the intestinal wall, and in one instance in the pancreas. These masses vary greatly in size and form, and produce a constriction of the lumen of the gut. The most common type develops predominantly in the wall of the intestine, is not circumscribed, and extends through a considerable length of the enteric wall, while those which begin in the mesenteric area and involve the wall of the intestine by direct continuity are more apt to be circumscribed. Adhesions to the adjacent viscera and parietal peritoneum are frequent.

In one of our cases (Case 1), which is typical of this class of cases, the terminal 2 feet of the ileum, the cæcum, and the first part of the ascending colon were markedly infiltrated, resulting in extensive encroachment upon the lumen. The maximum thickening occurred in the terminal 6 inches of the ileum (Fig. 1),

producing an almost complete occlusion of the canal, with marked dilatation of the ileum and constriction of the cæcum. The mucosa of the terminal ileum was extensively ulcerated. Large areas of mucosa were absent in places, suggesting coalescence of smaller ulcerated surfaces. In other places small ulcers were present, with intervening polypoid projections of mucosa (Figs. 1 and 2), which seem to be remnants of mucosa not destroyed in the ulcerating process. In another of our cases (Case 2), the terminal 2 feet of the ileum and the cæcum were involved in the inflammatory process. In this case there was a marked thickening of the ileum and cæcum, with a maximum in the cæcum, producing an almost complete occlusion of the lumen at the ileo-cæcal junction. The mucosa of the ileum and cæcum was extensively ulcerated.

There is a marked edema and infiltration of all of the coats of the involved portion of the gastro-intestinal tract in those cases in which the tumor develops primarily in the intestinal wall. In our cases all of the layers of the wall were involved, though the greatest amount of thickening occurred in the serosa. Wilensky stated that these tumors involve all of the coats of the intestine, and that the infiltration is most prominent on the mucosal aspect in the majority of instances. The thickening of the serosa results in a distortion of the other layers and a progressive encroachment upon the lumen of the gut until it can no longer permit the passage of its contents.

The mucosa usually presents numerous small, irregular, ragged, superficial ulcerations, accompanied in some instances by innumerable polypoid outgrowths, which would seem to be the result of proliferation of the islands of mucosa not destroyed in the ulcerative process (Figs. 1 and 2). Wilensky stated that in those cases in which the tumor mass involved the wall of the intestine primarily

there was ulceration which was superficial and not extensive while in those instances in which there was involvement of the wall by extension from the mesenteric attachment, the mucosa appeared perfectly normal or slightly thickened.

Microscopically these granulomatous masses show in addition to ulceration of the mucosa (Fig. 2) wide variations in the fibroblastic changes and in the cellular content, varying from a richly cellular active inflammatory tissue to a firm, dense fibrous cicatrix. Abscesses are seen not infrequently in the indurated and thickened wall not being confined to any particular layer. The connective tissue stroma is made up of fibroblasts present in numerous polymorphonuclear leucocytes lymphocytes, eosinophiles, plasma cells, and mononuclear cells (Fig. 4). An area containing mast cells and large groups of lymphoid cells can be easily mistaken for carcinoma, while the small round cells may so predominate the picture as to make the tumor resemble sarcoma. The blood vascular changes vary from newly formed channels to those presenting greatly thickened well formed walls with surrounding peri vascular infiltration. The lymph channels in some instances show marked dilatation.

Many of these specimens show in all of the layers of the intestine not infrequent multinucleated giant cells which appear to be of the foreign body variety (Figs. 2, 3 and 5). These cells are large have irregular outlines, numerous nuclei irregularly placed and are located in spaces with smooth outlines (Fig. 5). Symmers states in Case 4 that there are 'occasional circumscribed tubercle-like formations composed practically exclusively of atypical giant cells with numerous minute tentacle like processes stretching out from the cytoplasm and enclosing small variously shaped colorless glazed particles, representing apparently foreign bodies. We are not prepared to say what is the nature of these foreign substances. It is suggested however that possibly they entered through the disintegrated mucosa.

Moschowitz and Wilensky after a study of the literature dealing with this malady arrived at the conclusion that undoubtedly

many if not a majority of the cases of so-called "hyperplastic tuberculosis of the colon" were really simple granuloma. They stated further that the described lesions of hyperplastic tuberculosis, in the majority of cases, were identical with the non-specific granuloma. Microscopically and macroscopically it is extremely difficult in many instances to differentiate between tuberculosis and non-specific granuloma.

A unique finding was manifested in one of our cases so far as we can determine. In Case 1 in which the terminal ileum, caecum, and ascending colon were involved there was present the greatly thickened terminal ileum and ileocecal valve together with a false passage extending from the lower end of the ileum into the caecum near the region of the base of the appendix removed at a former operation (Fig. 1).

ETIOLOGY

Though the etiological factor in these cases is not known it is our feeling that there is first an interruption in the continuity of the mucosa as a reaction to the presence of an infectious or toxic agent or an indefinite foreign body resulting in ulceration of the mucosa. With the destruction of the mucosa, active infection follows and extends into the wall of the intestine, setting up a low grade inflammatory process which manifests itself in the cellular infiltration and connective tissue formation which constitute these granulomata.

Senn in this country first described the non-specific granulomata. He believed that there was a mechanical disturbance in the blood supply causing a necrosis of the tissue supplied by the involved vessels. A low grade infection ensued, which a reparative process attempted to circumscribe. As a result of this reparative process, granulation tissue was formed in excess of the destructive forces, and a granulomatous tumor resulted.

It is interesting to comment that in many instances preceding the onset of symptoms and signs leading to operations for granulomata there has been an appendectomy performed. The intervals between these two operations have varied from a few months to

a few years. It does not seem likely that there can be any definite connection between an appendectomy preceding by several years the onset of symptoms and signs leading to an operation for a chronic granuloma. This seems particularly true when the granuloma occurs at a considerable distance from the point of the appendectomy.

Several writers have reported the finding of foreign bodies, such as fruit pits, pieces of bone, silk ligatures, instruments, sponges and towels within the granulomata removed at operation. Tietze reported a caecal granuloma following appendectomy in which was found the silk thread used to ligate the appendix. Schloffer described inflammatory tumors of the abdominal wall, arising after operations for hernia, in which silk sutures were occasionally found imbedded within the tumor. Schreiber reported a case in which many cherry and plum pits were found in a granuloma of the ileocaecal region. Morian and Jaffe each reported a case in which a piece of bone was found in a granuloma involving the colon. Wolfier and Lieblein have called attention to the frequency with which foreign bodies lodge in the caecum and set up inflammatory reactions. Senn reported a case in which parts of a fruit cake eaten 9 months previously were found to be the nucleus of a granuloma.

Not infrequently these granulomata have been found to form at the site of chronic ulcers of the stomach and intestines, usually following a small perforation of an ulcer. In 1898 Graesser called attention to inflammatory processes in the sigmoid, arising from acquired diverticula, though it is thought that these lesions were generally regarded to be hyperplastic tuberculosis of the intestine. Goto, Monsarrat, Burt and Fisher, Tietze, and Rosenheim, Strauss, Moschowitz and Wilensky and other writers have reported dysentery or colitis as preceding the onset of these granulomata. Tietze reported one case in which an inflammatory tumor developed in the sigmoid following an irrigation with a strong solution of silver nitrate.

Mock reported the formation of a granulomatous mass at the site of a partial intestinal obstruction which had resulted from

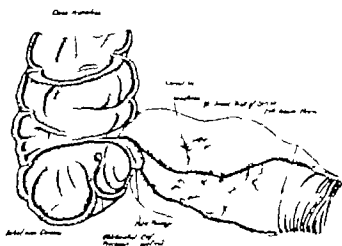


Fig. 1. Drawing of the ileocaecal region of S. C. (Case 1). This presents the characteristic marked thickening of the caecum, containing areas of necrosis and abscess, connecting with the lumen of the ileum. The muscular layer is somewhat thickened and distorted. The mucosa is absent except for polypoid projections, consisting of remnants of the mucosa, with intervening punched out ulcerations. A false passage between the ileum and caecum is seen near the ileocaecal valve.

pericolonic adhesions, another mass at the site of a vesico-intestinal fistula, one around a silk ligature used in the performance of a gastro-enterostomy, another in which the nucleus was a small towel left in the abdomen during a previous cholecystectomy, and still another in the transverse colon secondary to a retroperitoneal lymph gland infection, and one in the pancreas of uncertain origin.

Massive ligatures of the omentum have been reported as causing the formation of these granulomata. Bull in 1893, Coley, in 1901, and later Braun called attention to the chronic inflammatory thickening of the omentum as a result of its ligation during operations.

SYMPTOMS AND SIGNS

This lesion presents no characteristic clinical concept, though the presence of a mass in the abdomen and stenosis of the lumen of the gut are the most constant findings when the patient seeks surgical aid.

The symptomatology varies with the development of the pathological states. In the early stage, when the lesion is essentially inflammatory, there are no subjective or roentgenologic evidences of obstruction. Mild aching abdominal pain and local tenderness, with inconstant nausea and vomiting, a py



Fig. 3. Photomicrograph from Case showing ulceration of the mucosa extending up to the edge of one of the polypoid projections, composed of non-disintegrated mucosa, which has become hypertrophied.

retic reaction of 100 degrees F and a leucocytosis of 12 000 represent the usual attacks, though occasionally these symptoms become very severe and suggest acute abdominal pathology in the form of acute appendicitis or acute diverticulitis. These complaints are usually of long duration and have generally shown periods of quiescence and exacerbation.

As the infiltration increases and the pathological state becomes more marked the symptoms change form and indicate an obstructive lesion. The attacks become more frequent the pain more severe and colic-like in type, local tenderness is more marked, nausea and vomiting are more frequent and pronounced, pyrexia and anorexia are more marked there is increased loss of weight and weakness and progressive constipation. Not infrequently this infiltration continues until there is almost complete obliteration of the lumen of the gut with its consequent obstipation. In some instances instead of increasing constipation there is fluidity of the bowel contents with frequent evacuations, particularly when the pathology is located in the right half of the colon. When the pathology is present in the left half of the large bowel, constipation is the rule.

One of our patients (M. R.) suffered from very frequent stools for many years preceding the onset of the symptoms and signs leading to the operation for this granulomatous condition.

DIAGNOSIS

This condition is most difficult to diagnose and prior to operation is generally considered to be a malignant growth hyperplastic tuberculosis, sarcoma mesenteric lymphadenitis, appendicitis, or Hodgkin's disease. Syphilitic gumma of the intestine, anthrax and blastomycosis are to be considered.

Even though a definite diagnosis of granuloma cannot be made prior to operation the chronicity of ill health with exacerbations of good health increasing constipation frequent loose stools with or without mucus or blood loss of weight cachexia with or without marked anemia anorexia and the presence of an intra-abdominal mass should cause the surgeon to operate irrespective of whether or not the roentgenological examination reveals a stenosis of the intestinal tract.

A roentgenological examination is of little value in establishing a definite diagnosis of granuloma. In the early stages of constriction of the lumen, the X-ray findings are most often negative, though with further infiltration of the wall with its incidental encroachment upon the lumen, evidences of obstruction become noticeable on the roentgenographic plates. The irregular projection of barium into the crevices or extensions from the lumen of the gut into the mass is suggestive of granuloma.

A rapidly developing marked anemia is very strongly suggestive of a carcinoma of the cecum or ascending colon, whereas a fairly normal blood count in the presence of a mass in this region is more indicative of a tumor of the non specific variety.

TREATMENT

The treatment par excellence is operation. Without it most of these patients will progress to a complete obstruction. In the vast majority of instances they are suffering from a partial or complete enteric obstruction before they seek surgical aid or will submit to operative intervention.

The ideal procedure is resection of the involved part of the alimentary tract, after which we prefer to establish an end-to-end or a side-to-side anastomosis and complete the operation in one stage. This is particularly true when the small intestine is the site of the tumor mass. These patients tolerate this procedure very well when it is done with dispatch. In dealing with these tumors of the colon, it may be deemed wise to excise the tumor and establish a double barrelled colostomy preparatory to a secondary closure at a subsequent date. In some instances, where the patient is not a fairly good risk, a preliminary caecostomy or ileostomy may be performed followed in 7 to 14 days by extirpation of the tumor mass and re-establishment of the continuity of the intestine. If an abscess is found at the site of one of these tumor masses, simple incision and drainage often will be followed by the disappearance of the tumor and re-establishment of adequate bowel function.

Very often at the time of operation these tumor masses are mistaken for massive cancer, and considered to be inoperable particularly in the presence of widespread lymphadenopathy. Not infrequently a sidetracking procedure is the requisite to cure the patient. Several cases have been reported in which the tumor mass disappeared following the establishment of a gastro-enterostomy as a palliative measure in the presence of what was thought to be advanced carcinoma of the stomach.

In all cases in which it seems impossible to remove a growth a sidetracking procedure should be done if it is possible. A portion of the mass should be removed for pathological study. Occasionally these masses have been reported as disappearing following simple exploratory laparotomy. However if the mass does not disappear, the signs of obstruction and inflammatory reaction persist, and the pathologist reports the presence of inflammatory tissue, the surgeon may be justified in re-operating to make a more desperate attempt at removal of the tumor mass or the establishment of a sidetracking route.

The following case reports are presented as representing the pathological entity of non-specific granulomata of the intestine



Fig. 3. Photomicrograph from Case 1 presenting edema and cellular infiltration of the muscular layers. A small abscess is present at the junction of the circular and longitudinal muscle bundles, which show chronic inflammatory reaction, containing foreign body giant cells.

CASE 1 S G, male aged 18 No 64 153 admitted to hospital on April 12 1931 and discharged on May 12 1931. His chief complaint was intermittent cramps in the abdomen bleeding from the rectum weakness and general malaise for 2 years and loss of 30 pounds in three years. The family history was negative. Appendectomy was performed without drainage 6 years ago after which his convalescence was slow. There has been no known tuberculosis contact, and he has had no venereal diseases.

In the past 3 years this patient has lost 30 pounds and during the last 2 years he has suffered from anorexia, considerable belching and bloating after meals general malaise increasing in the past 6 months and frequent colds. He has experienced mild generalized abdominal cramps two or three times a week during the past 2 years. Six months ago the cramps grew more severe, and became localized to the right lower quadrant. Frequently these cramps have appeared 1 or 2 hours after the ingestion of green vegetables, raw fruit or other roughage, and have lasted for a few minutes at a time. A constant pain has been superimposed on the cramps in the right lower quadrant in the past 4 months and has been severe enough to awaken the patient at night and to interfere with his walking but not of such intensity as to require morphine. He has applied hot water bottles to his abdomen with some relief. No nausea or vomiting has been present at any time. Two years ago this patient began to feel pain at stool at irregular intervals and he has noticed a red tinge to the water in the bowl from time to time, and has observed some blood on the toilet



Fig. 4 Photomicrograph of a higher power of the smears from Case 1, presenting a connective tissue stroma made up of fibroblasts showing numerous polymorphonuclear leucocytes, lymphocytes, eosinophils, plasma cells, and mononuclear cells, which are the characteristic types of cells found in the inflammatory portion of this tissue.

paper. In the past few months his bowels have moved once a day under the influence of mineral oil once or twice a week. Physical examination revealed a poorly nourished and developed young male appearing very pallid, chronically ill and to have lost considerable weight. His heart and lungs were surgically competent, and his blood pressure was 118/80. His abdomen was soft and not distended. There was present a right lower quadrant scar just above which was an irregular, somewhat firm, moderately tender slightly movable mass the size of a lemon.

On admission the blood count showed red blood cells, 4,340,000 hemoglobin, 80 per cent white blood cells, 11,800 polymorphonuclear cells 80 per cent blood grouping Janakly I urinalysis essentially negative. X-ray picture of chest, while in the hospital, was negative for tuberculosis.

Pre-operative preparation. Fluids were forced orally and retention enemas of 3 ounces each of saline and tap water were given every 4 hours. Colonic irrigations were given night and morning for the 3 days preceding the operation. Pulvis glycyrrhizae compound drams ill were given the night before the operation and a colonic irrigation was administered 2 hours preceding the operation. We follow this general routine in all obstructive conditions involving the lower end of the ileum and the colon or rectum.

Operation was performed 3 days after admission, under ether anesthesia, 3 feet of the ileum, the cecum ascending colon, and one half of the trans-

verse colon being resected and an end-to-end anastomosis was established.

The condition of the patient immediately after the operation was good. Pain was controlled by two or three doses of $\frac{1}{4}$ grain morphine in 24 hours for the first 3 days. An occasional dose of $\frac{1}{5}$ grain of codeine sulphate and 10 grains of pyramidon was given for 2 more days. Fluids were tolerated well by mouth after 5 hours. One hypodermoclysis of 1,500 cubic centimeters of 5 per cent glucose in normal saline was given immediately after the operation. Retention enemas of 3 ounces each of saline and tap water every 4 hours were continued into the fourth day. Eleven hours after the operation the patient voided, and his output was satisfactory. Tea and oatmeal gruel were begun on the second day orange and grape juices were added on the third day coconuts and milk on the fifth and eggs on the ninth day. This patient subsisted entirely on this diet. Vomiting occurred once on the second day. Flatus was expelled through a rectal tube on the first day and on the second day he passed through the rectal tube on two occasions 10 ounces of dark red fluid resembling blood. On the third day an alum enema was productive of dark yellow fluid and flatus. From the fourth through the nineteenth day there were 3 to 5 yellow fluid stools in 24 hours. Subsequently until discharge there were 1 per day. Temperature pulse and respiratory rates showed only slight variations from the normal. Sutures were removed on the eleventh day and a slight amount of seropurulent discharge was expressed from the wound. A green purulent discharge persisted until the patient left the hospital at which time the wound was almost healed.

The report by the pathologists of the New York Post Graduate Medical School and Hospital is as follows: Grossly the specimens consist of a portion of the ileum, the cecum, a portion of the ascending colon and what appears to be a part of the omentum. The appendix is absent. From the gross appearance it is impossible to differentiate between the large and the small intestine. A tumor mass occupies a section of the intestine 10 centimeters in length at the junction of the ileum and the cecum. Near the tumor mass there are rounded projections which extend into the lumen. The small end of the intestine opens into this tumor mass by a somewhat tortuous pathway and at one side there is a false passage extending into the lumen of the intestine through the tumor mass near the ileocecal valve. There are some firm nodules, evidently lymph nodes, in the fat outside of the intestine.

Microscopic sections through the tumor mass near the central portion of the specimen, involving principally the ileocecal region, show the substance to consist largely of inflammatory fibrous and granulation tissue richly infiltrated throughout by abundant lymphocytes, plasma cells and in some places by very abundant polymorphonuclear leucocytes. There are also rather numerous multinucleated giant cells, which appear to be foreign body giant cells. There

are present abundant newly formed blood vessels in some parts of the granulation tissue and many of the lymph channels are distended to a diameter of $\frac{1}{4}$ millimeter. Some of the arteries show definite thickening of the walls. Tubercles are not recognized and there is nothing to suggest the presence of syphilis. Sections from the region of the false passage show highly purulent granulation tissue lining this channel. Sections of the lymph nodes reveal only a chronic inflammatory reaction. Diagnosis: Severe chronic productive purulent inflammation at the junction of the small and large intestine.

Dr. Douglas Symmers, director of laboratories, City of New York, reports on this specimen as follows: "Microscopic examination shows a marked chronic productive inflammatory lesion of the intestinal wall characterized by the overgrowth of connective tissue which in places is rich in small, thin walled, apparently newly formed blood vessels. Scattered through the connective tissue and interpolated between the muscle bundles of the gut are large numbers of richly cellular lymphoid foci of variable shapes and sizes and an occasional one showing an attempt at the formation of germinal follicles. Scattered through these lymphoid collections in places are giant cells of the Langerhans type, most of them associated with the presence of foreign particles, many of which present a smooth glazed appearance, as if representing perhaps, some altered form of waxy substance. In still other places are large collections of polynuclear leucocytes, representing abscesses. The lesion histologically appears to be a chronic productive inflammatory process associated with the presence of foreign body giant cells."

CASE 2 I. M. female, aged 39 years, No. 61 679 admitted to hospital January 4 and discharged on February 2, 1932. Her chief complaint was pain in the right lower quadrant of the abdomen, much eructation and heart burn for the past year, and the loss of 35 pounds in the past 4 months. Pelvic repair with appendectomy and right salpingo-oophorectomy was done 7 years ago and was followed by pneumonia and phlebitis.

About one year ago this patient had two attacks of abdominal pain in the right lower quadrant, both very severe and each lasting 2½ weeks. She experienced nausea and vomiting during the attacks. During the past year she has had digestive disturbances characterized by great quantities of gas orally inability to take fried or fatty foods, and by the presence of frequent heart burn. For the past 6 months she has had almost constant pain in the right side of the lower abdomen which has become more intense at 6 o'clock in the evening. Aspirin and frequently morphine have been required to produce rest. This patient has experienced frequent nausea and vomiting during these 6 months. She has been on a Sippy diet for 6 weeks, and has had no vomiting during this time. There has been no relationship between the appearance of the pain and meals. There has been no blood in the evacuations



Fig. 3 Photomicrograph of submucosa from Case 1 presenting a multinucleated giant cell of the foreign body type in a smoothly outlined space, which was apparently filled with foreign body material. The surrounding inflammatory reaction consists of fibroblasts and the numerous types of wandering cells.

though she has been chronically constipated. She has lost 35 pounds in the past 4 months her best weight being 195 pounds 4 months ago.

Physical examination revealed a young female appearing chronically ill, and to have lost considerable weight. The heart and lungs were surgically competent, and the blood pressure was 120/80. The abdomen was slightly distended, and there was a low midline scar from a previous operation. There was slight tenderness in the right upper quadrant and marked tenderness in the right lower quadrant. There was a very tender rather firm indefinitely outlined mass occupying most of the right lower quadrant. Slight edema was present in the right leg.

On admission the bleeding time was 2 minutes and the coagulation was complete in 4½ minutes. The urinalysis was essentially negative. Eleven days after the operation the blood count showed red blood cells 3,280,000 hemoglobin 61 per cent white blood cells 8,400, and polynuclear cells 66 per cent.

Operation was performed under ether anesthesia on the day following admission, with resection of 2½ feet of the ileum and the cecum. An end ileo-cecocolostomy was established. Grossly this resembled carcinoma. Two quarts of normal saline were left in the abdomen at the close of the operation. The condition of the patient was gratifying during the operation though she was very nervous and restless for many days. Pain subsided for the first 2 days with morphine.

quently rest was provided with luminal, 1 grain, three times a day. An irritating cough developed on the sixth day and persisted for 15 days. A hypodermoclysis was given immediately after the operation, and an infusion the next day. After the second day she retained oral fluids well, though retention enemas were continued through the second day. Slight vomiting occurred on the first day. Flatus was expelled freely after a milk and molasses enema was given on the first day because of considerable distention. On the third day the bowels began to move one to three times a day without enemas or cathartics. These were watery and were so when the patient was discharged from the hospital. The immediate postoperative reaction was mild, although considerable temperature reaction resulted from an extensive fascial slough which became evident after the sixth day.

The report by the pathologists of the New York Post Graduate Medical School and Hospital is as follows: The gross specimen consists of a portion of the ileum and the cecum. Thirty-five centimeters from the ileocecal junction there is an ulcerating area 30 by 10 millimeters in diameter in the ileum. Its floor is gray and irregular. On the cecal side of the ileocecal junction the wall is thickened to 30 millimeters. This thickening apparently occludes the cecal pocket. On section the wall is fibrous, and the mucous membrane is highly edematous. No glands are palpated in the attached fat. There is no appendix. Microscopic sections through the ulcer in the small intestine show abundant fibrinopurulent exudate on the surface of the ulcer. The submucous layer is thickened by increase in fibrous tissue, in which there are moderately numerous lymphocytes and polymorphous leukocytes. The circular muscle coat is hypertrophied. Sections through the wall of the cecum also show ulceration, which is also covered by abundant fibrinopurulent exudate. The wall of the intestine is greatly distorted by scar tissue in this region, and there is a marked increase of fibrous tissue in the subserous coat. The entire thickness of the wall is infiltrated by wandering cells. There is no evidence of tuberculosis or of neoplasia. Diagnosis: chronic ulcerative inflammation of the lower end of the ileum and of the cecum.

CASE 3. M. R. female aged 42 years, No. 64,981 admitted to hospital May 11, 1931, and discharged on May 15, 1931. Her chief complaints were pain in the abdomen, which had been intermittent for 11 years, and became worse in the past 3 months. diarrhoea for 11 years, loss of weight, pain in the left kidney region for 4 months. The family history was irrelevant. She had had a nervous breakdown 13 years ago with persistent nervousness. *appendectomy* with drainage 9 years ago, after which she never felt perfectly well. *laparotomy* 3 years ago for polyp of the uterus. *gastro-intestinal X-rays* taken in another hospital 7 weeks prior to admission showed only an irritable colon.

Eleven years ago there developed a frequency of bowel movements with as many as 20 in 24 hours,

associated with an inconstant burning sensation in the rectum. The movements gradually decreased to three to five a day and for the 3 weeks prior to admission there were two or three small, watery movements per day. For the past 3 months there has been present a severe aching pain over the right lower quadrant, with marked tenderness. Though in its incidence principally nocturnal, this pain has been present both day and night, and has been extremely severe during the past 2 weeks. Frequent doses of morphine have been required for its relief in the past 3 months. This patient has experienced pain, insidious in onset, beginning just lateral to the umbilicus and radiating to the left kidney region. These pains have become gradually more severe and have been worse in a reclining position. Her appetite has been poor for 11 years, and anorexia has been marked for several months. Two months ago she vomited some bile streaked with blood, and during the past 6 weeks has vomited almost every thing she has ingested. She has lost a great deal of weight in the past 6 months. Physical examination revealed a poorly nourished and developed, pallid, middle aged female appearing chronically ill. The skin was dry and showed a loss of much subcutaneous tissue. The heart and lungs were surgically competent, and the blood pressure was 103/76. The abdomen was protuberant more so on the right side. It presented two lower abdominal scars, resulting from previous operations. There was present in the right lower quadrant a very firm, freely movable, very tender irregular nodular mass, which extended up to the level of the umbilicus and medially almost to the midline. Over this mass there was flatness, though there was no evidence of fluid in the abdomen.

On admission the blood count showed red blood cells 3,350,000, haemoglobin, 61 per cent, white blood cells, 6,400, polymorphous cells, 76 per cent. The blood chemistry and urinalysis were normal.

Operation was performed 2 days after admission. Three feet of the lower ileum were resected, with the establishment of a side-to-side anastomosis. Three pints of normal saline were left in the abdomen at the close of the operation. An infusion of 1,000 cubic centimeters of 10 per cent dextrose in saline was given immediately after the operation. One hypodermoclysis was given the next day and retention enemas were continued for the first 24 hours. Fluids were tolerated well orally 11 hours after the operation. The urinary output was satisfactory. A soft diet was allowed on the third day and a regular diet on the seventh day. On the second day flatus and brown fluid were expelled through a rectal tube and on the fourth day there was a fluid evacuation, after which patient had one or two movements in 24 hours. Temperature, pulse and respiratory rates presented nothing unusual. Sutures were removed on the tenth day when patient was permitted out of bed. She was discharged on the fifteenth day eating a full diet, evacuating formed stools, with her wound healed by primary intention. X-rays of the

chest taken after discharge from the hospital were negative for tuberculosis.

The report by the pathologists at the New York Post Graduate Medical School and Hospital is as follows: Grossly the specimens consist of a portion of the small intestine, a piece of omentum and of what appears to be a greatly hypertrophied lymph node. The portion of intestine is greatly kinked on itself and held by firm fibrous adhesions. The wall is greatly thickened measuring 8 to 10 millimeters. On the mucosal surface there are numerous areas of ulceration as long as 100 millimeters, separated by small portions of normal mucosa. In the ulcerated areas there are small bits of mucosa, forming elevated, pedunculated projections. A small amount of purulent exudation is present on the inner surface. The mesentery is also somewhat thickened and fibrosed in places, and contains a few hypertrophied lymph nodes. *Microscopic* sections taken from different regions of the small intestine reveal a greatly thickened fibrosed and somewhat edematous wall. The entire thickness of the wall is infiltrated by a large number of polynuclear mononuclear and plasma cells. The mucosa is desquamated over large areas, with intervening intact mucosa, and there is a large amount of purulent exudation on its inner surface. At one place immediately below the mucous membrane there is a round area made up of epithelioid cells containing a few giant cells showing central areas of necrosis and lymphocytic infiltration around its periphery. This is a typical tubercle but there are no other such tubercles found in any sections, although in one place there are seen two multinucleated giant cells of the Langerhans type. Sections of the lymph node show marked hypertrophy, moderate endothelial proliferation, and in places a large amount of necrotic tissue containing numerous polynuclear cells.

Dr Douglas Symmers, director of laboratories, City of New York, reported on these microscopic sections as follows: "Microscopic examination shows the presence of a chronic productive inflammatory lesion of the gut wall associated with considerable overgrowth of connective tissue and the formation of lymphomatous collections. The mucosa in places is richly infiltrated by circumscribed collections of polynuclear leucocytes, the whole representing abscess formations. In other places the mucosa supports an occasional circumscribed tubercle like for formation composed practically exclusively of atypical giant cells with numerous minute tentacle like processes stretching out from the cytoplasm and enclosing small, variously shaped colorless, glazed particles representing apparently foreign bodies."

CASE 4. S. B. 60 years, female, in July 1926, began to complain of belching and bloating after meals and the onset of epigastric pain several hours after eating. She suffered from increasing constipation and general gastro-intestinal disturbances. On August 11, 1926 the roentgenologist at the Nyack Hospital reported as follows: The gall bladder takes the dye normally. A uniform shadow was present

except for a small irregular shadow near the cystic duct. The stomach appears normal in size, shape and position and in peristaltic action. There is a persistent defect of the duodenal bulb, which is believed to be due to gall-bladder pathology. Following this the patient improved somewhat on diet, medication and mild laxatives. In December 1926, attacks of apparent gall-stone colic became more frequent and severe. Wassermann reactions taken on two occasions were negative. This patient was admitted to the Nyack Hospital on January 8 1927, and on the following day was operated on by the senior author.

The gall bladder was pathological, and there was present a large, firm ulcerative mass involving the terminal ileum, caecum and ascending colon which apparently produced complete obstruction. The gall bladder was removed. The terminal ileum, caecum, ascending colon, and a portion of the transverse colon were resected, followed by an anastomosis of the ileum to the transverse colon. Drainage was instituted.

After a stormy course this patient was discharged from the hospital with a fecal fistula and continued to improve until August 1927 when evidence of complete intestinal obstruction occurred. On August 28, 1927, her abdomen was reopened and the fistula was found between the ileum and the colon. A large inflammatory mass was found to have formed in the ileum at the site of the anastomosis, producing a complete obstruction. A section of the ileum 24 inches in length, was removed, and an anastomosis again established between the ileum and the colon. This patient expired on the sixth day after operation.

Grossly the specimen is a portion of the small intestine 145 by 33 by 52 millimeters. For a distance of 60 millimeters the wall is very markedly thickened reaching 9 millimeters in places, and there is a sudden change in the mobility of the rugae of the mucous membrane in this area. There are several small papillary projections of the mucous membrane into the lumen. There is a small fistulous opening leading from the interior into the surrounding fat tissue, into which a probe can be introduced for a distance of 20 millimeters just at the border of the normal and the thickened mucous membrane. Microscopic sections at the junction of the normal and the markedly thickened wall of the intestine show a sudden increase in connective tissue elements, marked thickening of all of the layers and proliferation of fibroblasts. There are numerous collections of small round cells and several formations of follicles. Some of these follicles simulate tubercles, but in their composition they are not characteristic of nodules produced by the bacillus tuberculosis or its toxin.

Diagnosis: Marked chronic progressive inflammatory process of the small intestine of unknown etiology.

CASE 5. E. D. female, 37 years. Her chief complaint was that she had been sleepy most of the time for several months and had generalized abdominal

discomfort for one month prior to admission to the hospital. She had been an invalid for 17 years, suffering from chronic arthritis. Her legs were ankylosed at the knees and hips.

In the latter part of the winter of 1922 this patient felt indisposed, but had no specific complaints except that she felt sleepy most of the time. In September 1923 she experienced some generalized abdominal discomfort which was not acute. She was seen by her family physician who discovered a mass in the right inguinal region.

On October 1, 1923, a large inguinal abscess was incised and drained by the senior author at the Nyack Hospital. Three days later a fecal fistula developed at the site of the incision. After 10 weeks in the hospital this patient returned home where her general health continued to improve though the fistula remained unchanged. On September 16, 1924, this patient was again operated upon by the senior author who found the right side of the pelvis filled with a large firm, irregular mass, consisting of the cecum, part of the ascending colon, and a considerable length of the small intestine. Several feet of the ileum, the cecum and the ascending colon were resected, followed by an anastomosis of the ileum with the transverse colon. Drainage was instituted. This patient made a satisfactory recovery and she was discharged on October 23, 1924. On March 22, 1932 she had no gastric or intestinal disturbance and was in good general health.

At the time of operation the specimen, consisting of numerous coils of intestine firmly matted together grossly appeared to be identical with these non-specific granulomata. It is regretted that the pathological report has been lost.

PROGNOSIS

The prognosis following operative intervention is excellent. Moynihan, Robson and others have stated that these granulomatous masses usually disappear following the simple operative procedures in which the visceral contents are sidetracked. This is a most important diagnostic and prognostic characteristic.

CONCLUSIONS

1. Non-specific granulomata are chronic inflammatory tumor like masses which may involve any part of the gastro-intestinal tract. There is encroachment upon the lumen of the intestine as a result of infiltration which may predominate in the wall proper or extend from the mesenteric area and produce an intestinal obstruction.

2. The etiological factor in the production of these granulomata is not known. Foreign

bodies have been found in many of the cases reported. It is our belief that ulceration of the mucosa follows a reaction to infection or a foreign body and that a chronic inflammatory response results in the tumor like formation.

3. A diagnosis of the non-specific granulomata is usually possible only by microscopic examination of tissue removed at operation. Grossly these masses are generally mistaken for carcinoma or tuberculosis of the enteric canal.

4. Excision of the tumor mass should be done wherever possible. If removal is not feasible and obstruction of the bowel is established or imminent a simple sidetracking anastomosis should be performed. The tumor mass has been said to disappear following a simple laparotomy without any anastomosis of the intestines. A portion of the tumor mass should be removed for microscopic study.

5. The prognosis is excellent following extirpation of the tumor mass or the establishment of a sidetracking route.

6. Clinically the symptomatology varies with the development of the pathological states. When the lesion is principally inflammatory there is no evidence of obstruction though as the infiltration increases with its encroachment upon the lumen of the intestine, there appear signs of intestinal obstruction.

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STUDIES ON TUMOR METASTASIS

2 THE DISTRIBUTION OF METASTASES IN CANCER OF THE BREAST

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FEW malignant tumors show as wide variation in frequency and extent of metastasis as do the various carcinomata of the breast. On the one hand it is not infrequent to see a large colloid carcinoma of the breast of some years' duration without even involvement of the regional nodes whereas in other cases a small, inconspicuous mass apparently of short duration will show the most bizarre and widespread metastases. At times, unfortunately the first symptoms noted are those due to metastases as a pathological fracture or intracranial pressure.

The present study is based on 162 autopsied cases of breast cancer selected from the New England Deaconess, Pondville, and Huntington Memorial Hospitals, and the House of the Good Samaritan. We have attempted to divide the cases of carcinoma into three groups on the basis of their histological appearance. The least differentiated is the carcinoma simplex in which the tumor is growing in solid masses or cords of cells without alveolar formation. This tumor may be either scirrhous or medullary in its local lesion and metastases, with all gradations between. No significant variation has been detected in the behavior of the scirrhous and the medullary types, so therefore they are not separately considered in the present study. In general it may be said that our findings bear out the clinical observation that the larger and more bulky the local lesion the less extensive the distribution of metastases is apt to be.

More highly differentiated than the carcinoma simplex is the adenocarcinoma. In this form of tumor under our classification, at least one fourth of the tumor shows formation of definite alveoli. Here again the amount of stroma may vary greatly. Occasionally the metastases of such a tumor will show no alveoli.

A third, the most highly differentiated group, is the colloid carcinoma, characterized by the

presence of a great amount of mucinous secretion the absence of early metastases a relatively limited distribution of late metastases and as a rule very large local lesion.

In addition to these groups, which number 153 cases, were 5 cases of carcinoma that could not be classified, 2 cases of epidermoid carcinoma apparently originating from Paget's disease, 1 lymphoblastoma and 1 undifferentiated sarcoma, probably fibrosarcoma.

All the cases except the sarcoma occurred in females.

We have been able to confirm in part on this material Greenough's observations on the correlation of histological variation with prognosis. The time of metastasis is later in the more differentiated tumors, thus improving somewhat the prognosis as this holds true for the untreated cases and the cases showing metastasis before treatment (Table III). The presence of a fairly high proportion of metastases from tumors of all histological types does not permit too great reliance on grading. A wide variation of histological types is presented by the material. Our experience has been much more in accord with that of Reimann, and we feel that the wide variation in histology in the same tumor emphasized by Reimann, Ingleby, and others precludes any satisfactory histological grading. Even when the tumor presents a fairly uniform appearance, our attempts at grading have been unsuccessful. It may well be objected that an autopsy series is unduly weighted with cases of high malignancy. Certainly so far as distribution of metastases is concerned there is but little evidence of correlation between histological appearance and extent of metastasis. Size of the tumor cells has apparently little or no significance. However, the proportion of various grades corresponds fairly well with that found in our routine surgical material.

It must not be inferred from the foregoing that there is absolutely no correlation between

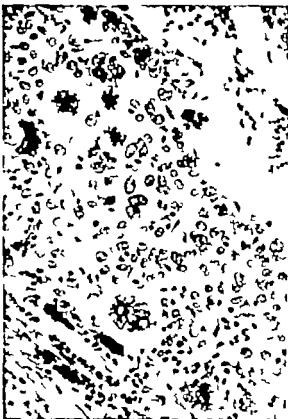


Fig. 1. Abnormal mitoses in carcinoma of the breast. Case 3. 3054. $\times 500$.

histological appearance of the lesion in the breast and prognosis or distribution of metastases. In certain cases of markedly anaplastic tumors, duration of life has been short and distribution of metastases has been wide. If any one factor stands out more definitely than others as a criterion of high malignancy in this group it is the occurrence of large numbers of abnormal mitotic figures. The frequency of mitotic figures of the normal type applies more to the local rate of growth than to the likelihood of metastasis. However I have yet to see a tumor containing numerous mitoses of the type shown in Figure 1 fail to metastasize rather widely or kill promptly as compared with the ordinary run of breast tumors.

As may be seen from Table I, operation was the predominant method of treatment in this group of cases. It is rather striking that 31 patients received either no treatment or palliative treatment and 15 additional pa-



Fig. 2. X-ray of pelvis showing metastases from carcinoma of breast. Case 5. 3.

tients received only X ray and 3 only radium treatment, which might well also be grouped in the palliative class.¹ Local recurrence was noted in 1 case of colloid carcinoma, 1 of unclassified carcinoma, 1 of epidermoid carcinoma, 1 of sarcoma, 30 (48 per cent) of adenocarcinoma, and 40 (46 per cent) of carcinoma simplex.

When one considers that of 113 intensively treated cases 74 showed local recurrence it is at first glance a reflection on the types of treatment used. However when it is remembered that this series is based on autopsied cases the emphasis shifts, simply calling attention to the grave prognostic significance of this condition.

The average age at death of our cases, 57 years for the adenocarcinoma and the carcinoma simplex groups, fairly closely corresponds with that noted by other observers. The total duration from the onset of symptoms also corresponds quite closely with Wainwright's figures, being 3.2 years for the adenocarcinoma, 3.1 years for the carcinoma simplex group and 3.1 years for the unclassified carcinomata. The colloid carcinomata and the epidermoid carcinomata have a much longer duration 8 years and 6.5 years respectively though of course the series is too small to be significant. The delay between onset of symptoms and treatment in cases of adenocarcinoma and carcinoma simplex was approximately 10 months.

No other common cancer shows as wide distribution of metastases as does that of the breast. Only 8 cases failed to show metas-

¹These cases were advanced when first treated.

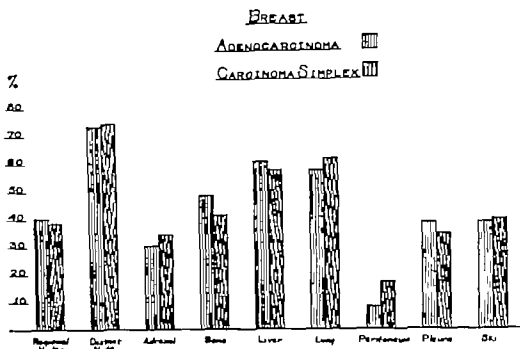


Fig. 3. Straight vertical lines show breast adenocarcinoma, crossed lines, breast carcinoma simplex.

tases at autopsy. The 154 cases with metastasis showed a total of 781 organs or tissues involved, an average of over 5 per case. There were actually far more metastases than these, as usually the metastases in a given site are multiple rather than solitary. When it is remembered that of these cases 113 had had radical operation with removal of the regional lymph nodes, in effect ruling out their most common site of metastasis, the number is even more striking. These radical operations of course explain the somewhat anomalous situation illustrated in both Table II and Figure 3, in which there are considerably fewer metastases to regional nodes than to distant nodes.

In this series of cases the eye, the middle ear, the pineal gland, and the nasopharynx are practically the only tissues to be spared. The pituitary was involved once, a parathyroid once, the thyroid 4 times, one or both ovaries 15 times, the heart 7 times. By far the most frequent site of involvement is the distant lymph nodes. Following these in order of frequency are the lungs, liver, bone, regional lymph nodes, skin, pleura, and adrenal glands (Table II).

Not only is the distribution of metastases in these cancers of the breast particularly wide from the standpoint of space but in point of time as well. By study of the history, and of

the gross and microscopic appearance of the metastases, we have attempted to estimate the time at which various metastases developed. The results are of course only approximate, but none the less of some interest. Thus in both treated and untreated cases of adenocarcinoma and carcinoma simplex 129 metastases appeared within 1 year before treatment, 27 two years before, 2 three years, 4 four years, and 4 over four years (see Table III).

In the treated cases 295 metastases apparently developed in the first year after treatment, 141 within the second year, 48 within the third year, 7 within the fourth year, and 58 after 4 years, some of the latter developing so far as could be determined as late as 12 years after treatment. These late metastases are particularly apt to be single. Bone and brain, and lung are particularly frequent sites of late development, although the liver is also fairly frequently involved. Skin metastases are more consistently late in development than any other one group. The other breast was the site of metastasis in 20 instances, being involved within 2 years of the time of treatment in all but 2 of the 20 cases.

The adrenal glands were involved in 50 cases, far more frequently than any other of the ductless glands. This is due chiefly to the location of the glands or their lymphatic drain

TABLE I—CANCER OF THE BREAST

| | Total cases | M | F | Average age, years | Average duration before treatment | Not staged, cases | Average duration after treatment | Total duration | Average duration untreated | No treatment or treatment by X-ray, cases | Treated by operation, cases | Treated by radiation, cases | Treated by X-ray, cases | Combined breast mast., cases | With local recurrence, cases | With no recid. later, cases |
|------------------------------------|-------------|---|----|--------------------|-----------------------------------|-------------------|----------------------------------|----------------|----------------------------|---|-----------------------------|-----------------------------|-------------------------|------------------------------|------------------------------|-----------------------------|
| Adenocarcinoma | 43 | — | 43 | 51.6 | 7.6 mos. | 8 | 3 yrs. | 3 yrs. | 7 yrs. | 3 | 27 | — | — | 9 | 10 | — |
| Carcinoma simplex | 27 | — | 27 | 57.6 | 5 mos. | 3 | 3 yrs. | 3 yrs. | 3 yrs. | 3 | 24 | — | — | — | 40 | — |
| Colloid carcinoma | 3 | — | 3 | 85 | 3 yrs. | — | 6 yrs. | 6 yrs. | 6 yrs. | — | — | — | — | — | — | — |
| Lymphoblastoma | — | — | — | 46 | — | — | 8 yrs. | 8 yrs. | — | — | — | — | — | — | — | — |
| Carcinoma, medullary or not staged | 1 | — | 1 | 67 | 3 yrs. | — | 4 yrs. | 3 yrs. | 4 yrs. | — | — | — | — | — | — | — |
| Epidermal carcinoma | — | — | — | 78 | — | — | 3 yrs. | 6 yrs. | 3 yrs. | — | — | — | — | — | — | — |
| Carcinoma, undifferentiated | — | — | — | 65 | 1 mos. | — | 6 mos. | 6 yrs. | — | — | — | — | — | — | — | — |

(Total duration includes untreated cases as well as treated)

TABLE II—DISTRIBUTION OF METASTASES

| | Number of Cases | Number of cases of breast cancer with metastases to | | | | | | | |
|-----------------------------|-----------------|---|---------------|---------|------|-------|------|----------|--------|
| | | Regional nodes | Distant nodes | Adrenal | Bone | Liver | Lung | Pancreas | Plasma |
| Adenocarcinoma | 6 | 1 | 46 | 19 | 10 | 15 | 26 | 1 | 24 |
| Carcinoma simplex | 87 | 23 | 61 | 30 | 26 | 20 | 6 | 3 | 10 |
| Colloid carcinoma | — | — | 1 | — | — | — | 3 | — | — |
| Lymphoblastoma | — | — | — | — | — | — | — | — | — |
| Carcinoma, not staged | 1 | — | — | — | — | — | — | — | — |
| Epidermal carcinoma | — | — | — | — | — | — | — | — | — |
| Carcinoma, undifferentiated | — | — | — | — | — | — | — | — | — |

age rather than their blood supply shown by the fact that the thyroid with an equal or possibly more abundant blood supply was involved only 4 times. The right adrenal is more frequently involved than the left, and often the liver also shows metastases. Solitary metastases are the rule and the medulla is a more frequent site than the cortex.

The spleen is not uncommonly (23 instances) a site of metastasis although as a rule the metastases are small. This frequent involvement lends little credence to the assumed resistance of the spleen to the development of cancer. The capsule of the spleen is involved in peritoneal metastases fully as often as one would expect from its somewhat protected location.

We feel that we have noted most of the metastases to bone in this group of cases. In a number of instances where roentgenological examination had not been done fairly recently before, X-ray studies were made after death.

Unfortunately we have not distinguished in all instances between osteoclastic and osteosclerotic metastases. In general the osteoclastic type predominates. By far the commonest sites are the lumbar vertebrae and the upper ends of the femora although in some cases almost every bone in the body is involved (Fig. 2). In a study of the clinical records, it was noted that pain called attention early to the vertebral metastases while usually femoral metastases were noted as a result of X-ray examination or pathological fracture.

TABLE III —PROBABLE TIME OF DEVELOPMENT OF METASTASES BEFORE TREATMENT—(UNTREATED AND TREATED CASES)

| | Adeno- carcinoma | Carcinoma simplex |
|-------------------|---------------------|----------------------|
| Under 1 year | 58 | 71 |
| 1-2 years | 19 | 8 |
| 2-3 years | — | 2 |
| 3-4 years | 1 | 3 |
| More than 4 years | — | 4 |
| Not stated | 5 | 23 |

We believe that the great majority of bone metastases are hematogenous. Those portions of bone with abundant blood supply are usually involved and the wide sinusoids of the marrow spaces offer ideal sites for deposition of tumor emboli. Moreover of 69 cases with metastases to bone 41 showed pulmonary metastases, thus providing easy and direct access to the systemic circulation. Evidence is fairly strong that minute viable tumor emboli may pass through the pulmonary circulation without establishment of metastases in the lungs.

Material suitable for study of the mode of transmission of metastases was not obtained in most of our cases. However in several, detailed studies were made of all tissues intervening between the primary tumor and involved axillary nodes. We found lymphatic permeation to occur in only one far advanced case with extremely widespread metastases. The evidence for embolic distribution is far stronger.

Distribution from the primary growth by way of the blood stream is rare, although at

TABLE IV —PROBABLE TIME OF DEVELOPMENT OF METASTASES AFTER TREATMENT

| | Adeno- carcinoma | Carcinoma simplex |
|-------------------|---------------------|----------------------|
| Under 1 year | 111 | 184 |
| 1-2 years | 61 | 80 |
| 2-3 years | 21 | 27 |
| 3-4 years | 18 | 19 |
| More than 4 years | 27 | 31 |

times clearcut invasion of vessels may be seen in the primary cancer particularly in the more anaplastic tumors. Usually when dissemination occurs by the blood stream the metastases in the lungs are the sources of tumor emboli.

SUMMARY AND CONCLUSIONS

- 1 The distribution of metastases in 162 autopsied cases of breast cancer is reported.
- 2 In general histological appearance is not related to the extent of metastases.
- 3 Metastases of breast cancers average over five per case.
- 4 Practically every organ or tissue of the body has been noted as a site of metastasis.
- 5 Metastasis occurs usually by emboli in lymphatic channels.
- 6 Direct blood borne metastasis occasionally is seen.
- 7 Most osseous metastases are hematogenous.

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CLINICAL SURGERY

FROM THE GASTRIC SERVICE OF THE MEMORIAL HOSPITAL NEW YORK

THE JIANU GASTROSTOMY

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THE purpose of a gastrostomy is to afford an inlet for food and liquid in cases of inflammatory or neoplastic obstruction in the esophagus or cardiac end of the stomach. A permanent gastrostomy should fulfill the following requirements. There should be no leakage of food, liquids, or gastric juice from the stoma in order to avoid excoriation of skin or the necessity for wearing a dressing. The stoma of a gastrostomy should be controlled by a sphincter or valve. There should be no necessity for constantly wearing a tube which needs be inserted only at the time of feeding. The gastrostomy should be lined by mucosa as granulation tissue is unsuitable for a permanent fistula. The operation should be so planned that the food enters at the fundus rather than at the pyloric end of the stomach. It is highly desirable that the gastrostomy permits the ingestion of semisolid food such as ground meat as well as liquids. The possibility of resection of the lower

end of the esophagus in patients with suitable esophageal cancers, which lend themselves to successful extirpation, should be considered and a type of gastrostomy selected which may aid in the reconstruction of an esophagus. Another desideratum is that the canal extending from the stomach to the skin be as long and narrow as possible so that the feeding tube fits snugly when it is introduced furthermore the canal itself should bend and thereby prevent the regurgitation of digested food through the stoma.

There are conflicting opinions about the advisability of performing gastrostomy for inoperable carcinomata of the esophagus and cardia. It has been asserted by some physicians that life is not worth while if food must be ingested unnaturally through a gastrostomy rather than by normal mastication and deglutition. A well designed and functioning gastrostomy enables the patient with cancer of the esophagus or cardia to live

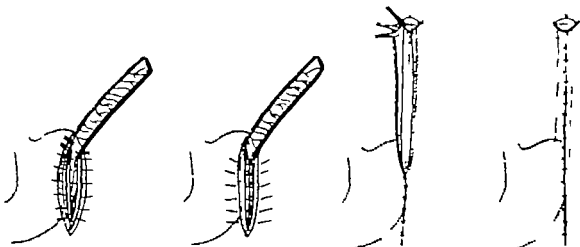


Fig. 1. The original Jianu gastrostomy. The fundus is anchored to the abdominal incision. Note the continuation of the skin incision superiorly onto the thorax in order to insulate the gastrostomy tube. (Jianu, A. Deutsche Zeitschr. f. Chir., 1912, cxviii, 383.)

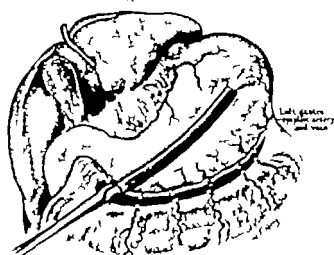


Fig. 3. Jianu gastrostomy. First step. Ligament and division of gastrocolic omentum with preservation of left gastro-epiploic artery. Right gastro-epiploic artery doubly clamped, divided, and ligated at pyloric end of stomach. Lower third of stomach to be severed between two long soft clamps (lower clamp not illustrated in order to show line of incision). Another small clamp is placed gently across base of flap at fundus to avoid soiling of operative field.

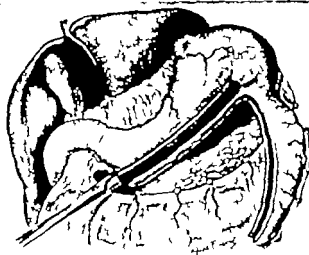


Fig. 3. Jianu gastrostomy. Second step. Semidiagrammatic sketch to show the construction of the gastrostomy tube. An inner Connell suture and an outer continuous Lembert suture close the stomach and the tube.

be employed and is seldom successful unless the carcinoma is situated in the upper half of the oesophagus. Bouginage is painful and attended by the dangers of perforation or hæmorrhage. Furthermore it must be repeated at frequent intervals. Retrograde bouginage through the gastrostomy is safer and more successful for

longer and to suffer less. The gain in weight after gastrostomy is convincing evidence of the value of this procedure. The presence of a gastrostomy does not prevent the intake of fluids by mouth if that be possible. In fact, many oesophageal cancers become pervious again and permit the patient to drink liquids after a gastrostomy has been performed because the infection of the cancer has subsided and there is less dilation of the oesophagus above the stenosing lesion. Bouginage as an alternative of gastrostomy has certain obvious disadvantages, it cannot always

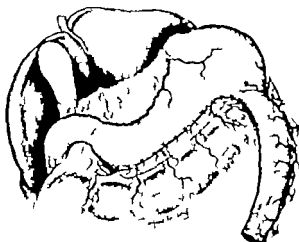


Fig. 4. Jianu gastrostomy. Third step. Reconstruction of stomach after formation of tube from greater curvature. The gastrocolic ligament is re-attached to the stomach above the suture line. The tube is 8 to 9 inches in length.

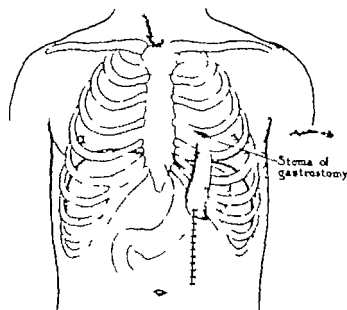


Fig. 5. Jianu gastrostomy. Fourth step. Location of incision for permanent gastrostomy in order to secure valve-like control against leakage by pressure against costal margin. If anastomosis to oesophageal stump is planned, the incision should be in mid-epigastrium, as the stoma then can be placed much higher. Abdominal wound completely closed. The tube emerges through muscle and fascia, then is drawn subcutaneously to the incision on chest selected for the stoma.

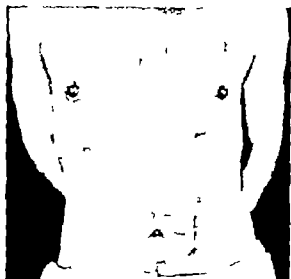


Fig. 6. Photograph of patient with jejunostomy. The stoma could have been placed on a level with the nipples if an esophagectomy and plastic restoration had been considered. There is no leakage of gastric contents and no excoriation of skin surrounding the stoma. This patient has regained his normal weight.

stenosing carcinomata of the cardia and terminal esophagus than peroral dilatation. Another argument supporting the advantage of gastrostomy over bouginage is the danger of dissemination of the carcinoma by the trauma incident to forceful dilatation. The unsatisfactory end-results and high mortality rate generally reported for gastrostomies can be attributed to the great delay before the operation is performed in the average case. The surgeon should anticipate complete obstruction of the esophagus or cardia and perform a gastrostomy before the patient becomes so emaciated and dehydrated as to be a poor operative risk.

According to my count at least 36 different methods of gastrostomy have been devised since the operation was first suggested in 1837 by Eggebert. The earliest record of its use was in 1841 when Blandinot performed this operation on a dog. In 1843 it was successfully and independently done in humans by Sédillot and Nélaton. A study of the evolution of gastrostomy reveals that only four different procedures are utilized. These are elaborated in some detail in the accompanying chart. The use of a simple gastric cone obtained from the anterior wall of the stomach as described by Sédillot, Frank, and others, seldom fulfills the requirements of a successful gastrostomy even when the various procedures to secure sphincteric control are em-



Fig. 7. Radiogram of stomach after introduction of barium sulphate through jejunostomy. The rubber catheter for feeding is in place. The goose neck is not completely visualized but its direction and end over the costal margin can be seen. The base of the tube continues with the fundus of the stomach.

ployed. It can be used only when the stomach is quite atonic and relaxed and in the majority of cases the gastrostomy is not water tight.

The Senn operation in which the cone of the anterior stomach wall is inverted by successively larger and wider pursestring sutures is probably the most successful of these simple types, as the inverted cone functions as a valve. The well known Witzel method is in general use for jejunostomy but it is inferior to the Marwedel technique because it tends to occlude the lumen of the stomach or jejunum. The Marwedel gastrostomy resembles the Witzel in general principle, except that after the rubber tube is introduced through an initial puncture wound and pursestring suture the stomach wall is not grooved entirely around the catheter but a linear incision is made through the seromuscular coat of the stomach or jejunum and the catheter is buried in the submucosa with the seromuscular layer sutured over it. In this type the gastrostomy canal and the rubber catheter is submucosal in location. The Witzel and Marwedel gastrostomies are not suitable for permanent intubation.

The substitution of another hollow organ such as the jejunum or transverse colon to be used as a gastrostomy tube is impractical, because the operation is difficult and frequently unsuccessful and the mortality rate is very high in marked disproportion to the safety of the simpler varieties of gastrostomy. This procedure should never be done if the only indication for the gastrostomy is to feed the patient. The only possible indication for this technique is when resection of the esophagus for carcinoma is planned and the surgeon wishes to attempt restoration of the continuity of the alimentary tract by reconstruction of a tube to serve as an esophagus. When the jejunum is used it necessitates the resection of a loop of this intestine reanastomosis of the jejunum resection of the esophagus, implantation of the jejunal loop into the stomach as well as to the distal end of the esophageal stump. In order to pull up such a loop as high as possible the mesentery must be cut from the oral end extending parallel to the intestine care being used to preserve the vascular arches close to the intestine. At the inner end of this isolated jejunum there remains a narrow mesenteric pedicle which maintains the blood supply to the intestine although gangrene frequently supervenes.

The most satisfactory gastrostomy is the type which is based on the construction of a tubed pedicled flap from the anterior wall or greater curvature of the stomach. Depage in 1901 first performed such a gastrostomy. He outlined a rectangular flap or trap-door with the incision entirely through the gastric wall on three sides of the rectangle the base being left at the lesser curvature of the stomach. This full thickness plastic flap is converted into a tube by continuous mucosal and seromuscular sutures this tube or goose-neck is lined with gastric mucosa and opens into the lesser curvature of the stomach. Under novocain anesthesia, a 3 inch vertical incision is made under the left costal margin. The anterior gastric wall is easily delivered through this small mid-rectus incision, and the construction of the plastic tube performed entirely without the abdominal cavity. It may be used when the stomach is immobile because the length of the flap permits its extension to the skin. It affords a valve lined by mucosa. It has an abundant blood supply and there is no danger of necrosis of the extremity of the flap. It extends upward to the skin and because of its attachment to the lesser curvature food and gastric juice do not regurgitate.

Janeway in 1913 modified this procedure by constructing the flap with the base at the greater

curvature. The advantage he claimed was that the suture line is placed on the upper surface of the tubular canal, thus subjecting it to less strain from the weight of the filled stomach. This objection to the Depage gastrostomy is not a valid one inasmuch as the stomach is seldom overdistended until the wound is entirely healed. Furthermore the Depage gastrostomy has a better blood supply from the lesser curvature than the Janeway gastrostomy can secure from the greater curvature of the stomach. An additional advantage the Depage has over the Janeway gastrostomy is that the location of the base of the tube is at the lesser curvature rather than at the greater curvature thereby insuring less regurgitation. If the body of the stomach (corpus ventriculi) is situated high under the costal margin or is retracted upward by a carcinoma of the cardia and lesser curvature the Janeway gastrostomy is preferable to the Depage because only the greater curvature may be low enough to serve as a base for the plastic tube if its direction (inward and downward) is maintained.

Hirsch, in 1911, devised a gastrostomy similar to the Depage except that the rectangular flap was very long and situated obliquely across the anterior gastric wall with the base near the cardia and the free end near the pylorus. This operation was performed only on dogs and apparently never was used on a human subject. Although Hirsch stated that several large arterial branches from the left superior gastric artery enter the base of the flap it is very likely that this flap has a poorer blood supply than either the Depage or the Janeway type of gastrostomy.

Amza Jianu, a Roumanian surgeon of Bucharest, devised a gastrostomy in 1912 which offered the advantages of serving not only as a feeding tube but was also suitable as the first step in the reconstruction of a new esophagus. In Jianu's method, the greater curvature of the stomach is converted into a plastic tube hinging at the fundus. Jianu performed this operation solely on dogs and human cadavers. Roepke was the first surgeon to do a Jianu gastrostomy on a living human subject. This method has found favor with certain American surgeons Willy Meyer in 1913 and Horsley at a later date both advocating its use. The procedure is not a difficult one and the danger to the patient is slight. It possesses all the advantages of the ordinary tubed gastrostomy and in addition may serve as the lower half of a reconstructed esophagus in the event that the surgeon later wishes to attempt an esophagectomy. This gastrostomy

may be done in patients with inoperable oesophageal carcinomata, for which no further operative procedures are planned. By so doing the surgeon acquires the necessary technical experience, so that in selected cases in which oesophagectomy is feasible, the first stage or construction of a long gastrostomy tube may be done with a great chance of success.

TECHNIQUE

The operation utilizes the greater curvature of the stomach to form a long pedicled tubed flap with the base at the fundus. If the gastrostomy is intended for feeding purposes only a high left mid rectus incision is done. If the surgeon plans to do an oesophagectomy and wishes to utilize the tube flap in the reconstruction of the oesophagus, then a midline epigastric incision is done, the incision being started as high as the xiphoid cartilage. The stomach wall is exposed by the incision. The gastrocolic ligament is divided at a distance of about 1 inch from the greater curvature, with care to preserve the left gastro-epiploic artery which will serve as the main blood supply of the future gastrostomy tube. The part of the gastrocolic ligament attached to the transverse colon is kept intact as it may be used to suspend the transverse colon and in some instances to protect the suture line of the stomach (Fig 4). The gastrosplenic ligament is also severed between two ligatures.

The stomach is now clamped longitudinally along the greater curvature with long soft rubber covered clamps beginning at the antrum and extending high onto the fundus (Fig 2). Horsley places these clamps midway between the greater and lesser curvatures, but it is my practice to extend them only one third of the way up from the greater curvature in order to leave more normal stomach. At the base of the proposed flap on the fundus, a short rubber covered clamp is placed gently in a transverse position in order to isolate this segment and to prevent leakage of gastric contents during the operation. This clamp should not be placed too tightly or it might interfere with circulation. The right gastro-epiploic artery is doubly clamped severed and doubly ligated at the distal end of the stomach. It is the left gastro-epiploic artery upon which the circulation of the flap is dependent.

The incision is made between the two clamps and extends from the antrum to the fundus. The incision is carried through both the anterior and posterior stomach walls, the leaves of which are sutured to construct a gastrostomy tube with a

lumen at least 1 inch or more in diameter (Fig 3). I have employed two layers of sutures, the inner a Connell suture of chromic catgut and a continuous serosal Lembert suture of silk.

If the gastrostomy is to be used only for feeding purposes, the gastrocolic ligament may then be sutured over the suture line in the stomach particularly at the angle of reflexion of the stomach onto the base of the tubed flap. It suspends the transverse colon and furthermore furnishes a defensive guard for the gastric suture line. On the contrary if the stoma of the gastrostomy is to be placed high on the chest wall or if the tube is delivered through a midline epigastric incision, the weight of the colon exerts too much tension on the stomach when the gastrocolic ligament is sutured to this organ.

In his original article Jannu described the anchorage of the stomach to the upper part of the abdominal wound by interrupted Lembert sutures. This procedure tends to prevent asculation of the fundus at the base of the tube and to avoid the formation of an hour glass stomach. It lessens considerably the tension on the tube caused by the weight of a distended stomach. The later authors do not stress this step sufficiently and many of them have probably not anchored the stomach as outlined by Jannu.

After the anterior and posterior edges of the stomach are sutured together and the suture is continued at the flap to form a closed tube this goose neck is gently drawn out through the upper end of the abdominal incision and placed upward over the chest wall in order to judge how high it can extend. The tube frequently measures 8 to 10 inches in length. A small transverse incision about $1\frac{1}{4}$ inches long is made, after the site of the stoma has been selected in this way. The surgeon then burrows through the subcutaneous tissues from this skin incision down over the ribs until a Kelly clamp enters the subcutaneous plane of the abdominal incision. This subcutaneous channel is dilated until it is much larger than the tube otherwise it may contract on healing and constrict the tube sufficiently to interfere with its blood supply. The surgeon introduces the clamp through the incision for the stoma, grasps with this clamp the extremity of the gastrostomy tube and draws it through this subcutaneous channel until the end of the tube reaches the incision in the skin. Infection of the subcutaneous channel may be avoided by temporarily inverting the tip of the goose-neck or tube by two sutures, or the end of the tube may be covered by a finger cot or a rubber condom. After the tube has been delivered through the

incision for the stoma, it may be left unopened for 24 to 48 hours at which time the occluding sutures are removed.

There is considerable risk of sacculation of the intra-abdominal portion of the tube and subsequent difficulty in feeding if the tube is left slack and is not pulled up snugly. The blood supply runs in a longitudinal direction, therefore any suture in the extremity of the tube should be placed in this same direction otherwise it may interfere with the blood supply of the tip with resultant ischemic necrosis.

In the original Jianu operation on dogs, the abdominal incision was extended upward onto the chest as high as the tube would reach. Then the skin incision was sutured over the tube (Fig. 1). Roepke, Willy Meyer, Horsley, and others who have employed the modified Jianu gastrostomy have all dispensed with this added incision and delivered the tube through a subcutaneous channel instead (Fig. 5). The danger of infection is probably greater with the number of sutures required for the long skin wound of Jianu than it is by burrowing the tube through a long subcutaneous channel.

The abdominal wound is closed in layers. The peritoneum and split rectus muscle are closed by continuous plain catgut sutures. The fascia is closed by interrupted chromic catgut sutures, which fit snugly but not too tightly around the tube. The skin is completely closed preferably by interrupted sutures in order to allow for drainage if it is necessary during the healing of the wound. Thus the tube extends through the peritoneal muscular and fascial layers but does not extend through the skin of the abdominal incision. A small drain is placed subcutaneously at the lower end of the abdominal wound.

The completed gastrostomy is ideal in every respect. The stoma is situated so high above the stomach that regurgitation of food and gastric juice never occurs. The tube is bent upward over the costal margin or over the xiphoid cartilage and in so doing obstructs the lumen sufficiently to serve as a very good valve and in this way also prevents the regurgitation of food through the gastrostomy. The blood supply is adequate and even the extremities of a very long tube will never suffer from ischemia. The rectus muscle may also serve as a sphincter. The tube has a much larger lumen than occurs in the Janeway or Depage gastrostomies and on this account it is possible to give semisolid food such as ground meat. Puréed vegetables and ground meat can later be given through this gastrostomy, by using a small grease gun for the introduction.

A rubber catheter, No. 12 or 14 French, is left in the gastrostomy during the first 10 days. Water and peptonized milk are given immediately after the operation and the liquid and semisolid diet increased quickly until the patient is soon on a well balanced, high caloric diet.

EVOLUTION OF GASTROSTOMY

- A. Elevation of simple cone from anterior wall of stomach.
Sédillot (1846)
 - 1 Use of rectus muscle as a sphincter for gastrostomy cone. Girard (1888) V. Hacker (1890) Jaboulay (1894) Terrier and Gosset (1902)
 - 2 Traction of gastric cone through oblique canals between muscles, fascia, and subcutaneous tissues to give sphincteric control. Hahn (1890) Sebanelli (1890) Hartmann (1891) Frank (1893)
 - 3 Rotation of gastric cone to form a valve for the gastrostomy. Ullmann (1894) Soulligoux (1901)
- B. Canalization of gastric wall.
 - 1 Invaginated gastric cone by series of pursestring sutures. Senn (1896) Fontan (1896)
 - 2 Intramural canal not lined by mucosa.
 - a. Puncture wound and inversion of sound or rubber catheter by plication of stomach wall with sero serosal sutures. Witzel (1891) Kocher (1901)
 - b. Puncture wound and burial of sound or rubber catheter in submucosal canal by suture of seromuscular coats. Marwedel (1896)
- C. Substitution of other hollow viscera as tubes between stomach and skin.
 - 1 Isolated, pedicled segment of jejunum. Roux (1907) Wullstein, Frangenheim (1911) Lexer (1911)
 - 2 Isolated pedicled segment of transverse colon. Kelling (1911) Vulliet (1911)
- D. Construction of tubed pedicled flaps from gastric wall.
 - 1 Tubed flap with base at lesser curvature. Depage (1901)
 - 2 Tubed flap from anterior stomach wall with free end near pylorus and base at cardia and fundus. Hirsch (1911)
 - 3 Tubed flap by severance of greater curvature with base at fundus. Jianu (1913)
 - 4 Tubed flap of anterior stomach wall with base at greater curvature. Janeway (1913)

SUMMARY

The evolution of the methods of gastrostomy is discussed. The indications, advantages, and technique of the Jianu gastrostomy are presented. The Jianu operation utilizes the greater curvature of the stomach to form a long tubed flap with the base at the fundus. This tube may be used not only for a gastrostomy but also as the initial step in the reconstruction of the esophagus.

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THE TRANSVERSE INCISION IN THE UPPER ABDOMEN

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OUR interest in the transverse incision in the upper abdomen was stimulated largely by dissatisfaction with the difficulties inherent in the more commonly used vertical incision. The latter is fundamentally unsuited to too many patients requiring operations on the extrahepatic biliary system, 40 per cent of those reported here being grossly obese. That one is working against the patient's efforts becomes obvious as soon as an inhalation anæsthetic is administered and the patient's attempts to obtain adequate pulmonary ventilation in the face of decreased vital capacity bear witness to the physiological and anatomical handicaps under which he lives. Though there is not a general realization that increased intra-abdominal tension and decreased vital capacity go hand in hand, all changes in intrathoracic or intra-abdominal tension being transmitted through the diaphragm, it is easy to predict during incision in which case proper closure will be easy and in which it will be difficult or impossible. When one has finally accomplished accurate closure of all layers in a half suffocated patient, whether the difficulty in gaseous exchange be in the pulmonary or in the internal respiration, there is little comfort in the immediate outlook for such patients usually have a stormy postoperative course with slight, clinically discernible cyanosis and persistent vomiting. We have had them report sudden relief after a sensation of 'something giving way'. In one patient, Miss M. B. (October 1931) efforts to close the posterior aponeurosis and peritoneum were finally abandoned, the omentum brought up to the wound and the rectus muscle (which had been split in its inner third) was closed as the deepest layer followed by the anterior aponeurosis and skin. She did not vomit following operation, showed none of the characteristic dusky color and anxious expression of those in whom the posterior aponeurosis is approximated and seemed indeed to have been under no greater strain than a slim person would have been after appendectomy through a McBurney incision. Re-examination in March 1933, showed deviation of the umbilicus 2 centimeters to the left (nerve injury) but a perfectly firm abdominal wall without transmission of impulse on cough or strain or bulging on sitting up. We are convinced that, by failing to close the posterior aponeurosis in her case we simply anticipated the tearing through of sutures that must

occur shortly after operation if the patient is to recover the pre-operative physiological status.

We were unwilling to face indefinitely a situation so unsatisfactory in immediate results and in its remote implications of hernia and adhesions. All true hernias through incisions as contrasted with weak abdominal walls due to nerve injury probably have their origin during postoperative convalescence in the hospital due to giving way of the suture in the posterior aponeurosis and peritoneum. Sprengel is quoted by Singleton as having observed this in those who died shortly after operation and one of us (W. B., Sr.) has repeatedly seen this. For these reasons we turned to the transverse incision in the upper abdomen as a truly anatomical and physiological procedure. We are so impressed with its value and find its drawbacks so few that we hope to encourage others to use it. The literature on the subject is small enough that a perusal of the original articles is well worth while. All contributors list very much the same dissatisfaction with the vertical incision and their unwillingness to give up the transverse incision once they have become familiar with its use. Sprengel, Perthes and Bakes, in Germany gave the greatest impetus to the procedure as a method of approach to the upper abdominal viscera though Maylard in England was perhaps the first to perform complete transverse division of all structures his report in 1907 is concerned with operations below the umbilicus. Clifford Collins, in the United States was attempting to solve the problem of a truly anatomical approach to the gall bladder and extrahepatic bile ducts and his contribution in 1908 has not received the attention that, historically, it deserves.

ANATOMY OF ABDOMINAL WALL
ABOVE THE UMBILICUS

The articles by Maylard, Southam, and Moschowitz go very fully into the anatomy and physiology of the anterior abdominal wall above the umbilicus and only a brief emphasis will be laid on certain points important to our purpose.

Muscles and fascia. The flat muscles (external oblique, internal oblique, and transversalis) the fibers of which are predominantly transverse in direction, are inserted into the linea alba by two fibrous aponeuroses one of which passes anterior to the rectus muscle, the other

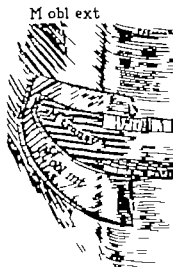


Fig. 1. Anatomical details of the right lateral abdominal wall just above the level of the umbilicus.

posterior to the rectus (Fig. 1). The anterior aponeurosis is formed by the fusion of the fascia of the external oblique with the anterior lamella of the fascia of the internal oblique. The posterior aponeurosis is formed by the fusion of the posterior lamella of the fascia of the internal oblique with the transversalis fascia. The anterior and posterior aponeuroses fuse to form the linea alba which is a thick, single layer structure. The correct physiological-anatomical conception is not of anterior and posterior layers of the "sheath of the rectus," but of *anterior and posterior aponeuroses* of the lateral abdominal muscles, shifting the emphasis to their origin and to the transverse direction through which their pull is exerted on the linea alba. McArthur emphasized the rôle of the transversalis as a muscle of respiration, and Sloan found that it requires a pull of 30 to 50 pounds to approximate the aponeuroses when divided vertically with the patient only lightly anesthetized when, however the aponeuroses were divided transversely only a negligible force was necessary to reunite them. This fact was confirmed both by Singleton and by Mason.

Each rectus muscle is firmly attached to the anterior aponeurosis by *lineae transversae*, one at about the level of the umbilicus, a second opposite the xiphoid, a third approximately between these points, and a fourth below the umbilicus. The *lineae transversae* do not often extend through more than half the thickness of the muscle, so that the posterior aspect of the rectus is only loosely attached to the posterior aponeurosis.

This division of the rectus into segments is further emphasized by the distribution of the nerves in the muscle.

Nerve supply. The rectus muscle is innervated by the fifth to the twelfth thoracic nerves, the oblique and transversalis muscles by the seventh to twelfth thoracic and the ileohypogastric and ilioinguinal branches of the first lumbar (18). The intercostal nerves enter the abdominal wall at the costal border lying between the internal oblique and the transversalis muscles. According to Quain (14) a very fine network of filaments runs medially at this level to give the parietal peritoneum its sensory and trophic innervation. The intercostal nerves continue medially approximately parallel to the fibers of the transversalis to pierce the posterior aponeurosis at the lateral border of the rectus. Each nerve then divides into two branches: (1) the larger proceeds medially lying posterior to the rectus, as far as the midline of the muscle which it enters, breaking up into a plexiform arrangement and giving off an anterior cutaneous branch which pierces the muscle anteriorly and does not appear to cross the midline (Southam) (2) the smaller branch pierces the outer half of the rectus, which it innervates. The seventh intercostal nerve terminates in the region of the xiphoid, the tenth at approximately the level of the umbilicus. In the operative fields of the upper abdomen, therefore, one will ordinarily encounter the eighth and ninth intercostal nerves and, if working lateral to the rectus muscle or near the umbilicus, may encounter the tenth. A vertical incision at the lateral border of the rectus will therefore destroy the entire nerve supply of that muscle to the corresponding level: one splitting the rectus lateral to its central line will destroy the innervation of its medial half. This was found to be the fact by Southam and other writers. Vertical incisions through the anterior aponeurosis with lateral retraction of the muscle and incision of the posterior aponeurosis in its inner third did not result in atrophy of the rectus.

Blood vessels. According to Maylard, the blood supply of the anterior abdominal wall is chiefly longitudinal and the most important vessels are the superior epigastric (O. T., internal mammary) and the inferior epigastric (O. T., deep epigastric) which above the umbilicus, lie on the posterior aponeurosis immediately posterior to the rectus they anastomose freely. More laterally the blood vessels and lymphatics run more transversely in a course similar to that of the intercostal nerves. The linea alba is avascular and is almost devoid of lymphatics.

LATER DEVELOPMENT OF UPPER ABDOMINAL INCISIONS

Since the appearance of the original papers in the English, German, and American literatures, there have been further contributions of various personal experiences with upper abdominal incisions, transverse in part or in whole. No serious adverse criticism of the plan has come to our attention. Modifications have been suggested from time to time with a view to overcoming the minor difficulties of the procedure which are encountered by everyone on first acquaintance with it. In general, those who have contributed to the subject have followed one of two plans, differentiated chiefly by their management of the rectus muscles.

1 *Direct transverse division of all layers, including the rectus.* Farr, 1915, Quain, 1920, Moore, 1922, and Southam, 1924, have followed the plan of Maylard, cross-cutting the rectus without preliminary hæmostatic and fixation sutures. Meyer 1915, Moschcowitz 1916, and Jones and McClure, 1930, have inserted such sutures before cutting the muscle as in Perthes' modification of Sprengel's incision. The former group feels that the rectus retracts only segmentally and to so slight an extent that an adequate repair is made as part of the closure of the anterior aponeurosis. Farr, indeed, measured 150 cases and reported that 1 centimeter of muscle invariably projected beyond the suture line in the aponeurosis. The latter group emphasizes the hæmostatic rather than the fixation purpose of the preliminary muscle suture.

2 *Transverse division of posterior aponeurosis without cross-cutting rectus.* McArthur, 1915, presented a muscle splitting incision for operations on the gall bladder like that suggested by Collins for cholecystostomy. The method of Sloan, 1927, consists of vertical incisions in both anterior aponeuroses, lateral retraction of both recti, and transverse division of the posterior aponeuroses extending through the linea alba. Singleton 1931 reported a modification of Sloan's method using a transverse incision through skin and fat and omitting the vertical incision in the anterior aponeurosis on the left; the recti are retracted laterally as by Sloan. Tate Mason, 1929, goes on the theory, for which there is considerable evidence, that a short incision is less apt to be followed by hernia than a long one and makes a left, paramedian, vertical incision from the xiphoid almost to the umbilicus and a shorter right paramedian vertical incision extending below the umbilicus, the lower end of the first incision and the upper end of the second are

joined by a transverse incision extending through the linea alba and both recti are retracted laterally, the transverse incision is overlapped in closure.

3 Particularly abroad, there have been efforts made to get more exposure than obtained through the classical transverse incision of all layers but they have not found favor in this country. Willy Meyer, who in 1915 reported using the straight transverse incision for the exposure of the stomach and duodenum, in 1917 favored the Perthes rectus flap operation (22 cases) for the gall bladder and bile ducts. He had also used the Koenig Kehr flap operation (3 cases). His illustrations show also a downward extension of the lateral transverse incision at the lateral edge of the right rectus as an aid in reaching the cæcum; this certainly endangers the tenth intercostal nerve.

ADVANTAGES COMMON TO TRANSVERSE INCISIONS

All modifications of the upper abdominal incision, transverse in all layers, present certain definite advantages over all forms of vertical incisions, including the so called Kammerer incision in which the rectus is retracted laterally out of its sheath. These have been discussed in such detail by the authors mentioned, especially Moschcowitz and Sloan, that to do more than enumerate the points of superiority would be superfluous. (1) Injury to the nerve supply is avoided. (2) The posterior aponeurosis of the flat muscles, the main supporting structure in the upper abdomen, is split parallel with the direction of its fibers. (3) Intra abdominal exposure is greatly improved, necessitating far less packing, handling, and retraction of viscera. (4) Closure is always facilitated. (5) Postoperative course in the hospital is distinctly smoother with noticeably less tendency to vomit, little pain on respiration, and shorter confinement to bed with consequent economic gain. (6) There is suggestive evidence that the risk of respiratory complications is less. (7) Decreased risk of hernia and adhesions and better cosmetic result.

DISADVANTAGES OF VARIOUS TYPES OF TRANSVERSE INCISIONS

It has been said already that various modifications of the original transverse incision of the type of Maylard and Sprengel have been devised to correct minor difficulties as they occurred to the individual operator. It is not to be expected that any single incision will best meet all requirements of upper abdominal surgery in the experience of any individual but a critical discussion of the good and bad points of each, though these be in part

only theoretical is desirable rather than other wise

1 (a) All the incisions that avoid cutting the rectus muscle (Bakes, Sloan, Singleton, Collins, Mason) involve the dissection of two large separate layers (skin and fat, rectus muscle) free from each other and from the underlying posterior aponeurosis, with the inevitable creation of extensive "dead space." Indeed, Singleton says,

"A collection of lymph may occasionally show beneath the skin some 2 or 3 weeks later but if left alone it will be absorbed within a few weeks." Our experience with fluid collections has been less happy as they have usually become infected requiring irrigation or through-and-through drainage.

(b) In our experience extensive retraction of the rectus in any direction causes hemorrhage from the vessels posterior to it which is harder to locate and stop than if it were anticipated during cross division of the muscle. It occurs, moreover at an unpredictable time during the operation.

(c) When the rectus is retracted laterally it is often sufficiently in the way during simple cholecystectomy seriously to limit one's room unless the linea alba be also divided. (d) Medial retraction of the rectus is apt to injure its nerve supply by stretching and (e) it blocks access to the linea alba when one wishes to divide it after one having started intra abdominal procedures.

(f) Bilateral exposure that is, transverse division of the linea alba and posterior aponeurosis of both sides with dissection and retraction of both rectus muscles (Sloan) involves about twice as much cutting during opening and suture during closure as simple bilateral transverse division of all layers this can readily be confirmed by measuring with a centimeter rule the total length of the incisions in different layers. (g) Incision of the same layer in two directions, with the production of points, is considered undesirable in all surgical procedures. This is particularly true of fascial planes which are relatively avascular structures.

2 (a) Those incisions which are designed with divisions of different layers in different directions or at different levels, producing a "muscle lined" wound through which intra abdominal tension does not have a direct path to the outside are open to the objections already cited in the cases of incisions of Sloan and Singleton. (b) The rectus flap operation of Perthes frees the rectus medially divides it transversely at a low level, then turns it upward and laterally the exposed posterior aponeurosis is incised close to and parallel with, the rib margin. Collins incision for the bile tracts is similar in its treatment of the posterior

aponeurosis, the skin and anterior aponeurosis being incised diagonally from above and medially downward and laterally and the rectus muscle retracted laterally from its sheath. This location of the incision in the posterior aponeurosis is not strictly parallel with its fibers and involves some cross-division of them (Meyer) above all, it is in such a position that if a hernia should occur repair would be next to impossible through lack of tissue in the superior shelf. We can find no reports on the incidence of hernia with these incisions, but the risk seems prohibitive to their use, which is not true of any of the objections cited to the other incisions discussed.

3 The classical incision, transverse in all layers and cross-dividing the rectus muscle has only one real objection, which is that the incision is carried straight down at one level through all planes and therefore offers a direct path to the outside through which intra abdominal tension may be exerted. Evisceration as the result of extensive wound infection is noted by only one author (Meyer) and that in a case of presumed tetanus infection from catgut. However incisions through different planes are more nearly ideal if staggered and we feel that we have evolved a muscle lined incision that meets this one theoretical objection. We can find no other evidence in the literature that transverse division of one or both recti is detrimental *per se* than the statement that there is some feeling against it.

PERSONAL EXPERIENCE AND SUMMARY OF CASES

Our own experience is limited to 28 cases during the past 16 months and we are now using routinely the incision to be described for all operations in the upper abdomen. The following is a summary of the essential circumstances of these cases.

1 The first 6 had a vertical incision carried down through skin, fat, and anterior aponeurosis, followed by retraction of the rectus muscle medially and transverse division of the posterior aponeurosis and peritoneum. In the next 13 cases, a classical transverse division of all layers was made in one plane. In the 9 remaining, the "staggered incision" was employed. The linea alba was incised 11 times part or all of the rectus of the opposite side was incised 4 times.

2 The following intra abdominal maneuvers were carried out: 17 cholecystectomies with incidental exploration of the common duct once when present the appendix was removed through the same incision except in 3 cases, in two of which supplementary McBurney incision was made at the same time in the third instance it

was done on the eighteenth postoperative day. Two explorations of the common duct with cholecystostomy through T tube, 5 cholecystostomies with Pezzar catheter 1 splenectomy 1 anterior pylorotomy (Judd) and appendectomy 1 ileosigmoidostomy 1 exploration and closure (in operable kidney tumor).

3 Of these patients, 11 weighed more than 170 pounds and of these only 3 were men.

4. Spinal anesthetic was used in one case (splenectomy). Nitrous oxide plus novocain in filtration of the skin incision line and block at the outer border of the rectus was used in the others supplementary ether was added in 2 cases both of them simple cholecystectomies. All patients except the one operated on under spinal anesthesia were given our routine pre anesthetic medication of 10 grains of phenobarbital sodium (in divided doses) and 3 grains of pento-barbital (Nembutal) orally with atropine but no morphine.

5 Five patients vomited one or more times in the first 24 hours after operation 10 had to be catheterized during this period.

6 The average number of days in bed after operation was 9.3 and the average number of days in hospital after operation was 13 leaving out of account 5 patients. Of these 2 were kept in bed 14 and 18 days, respectively before subsequent perineorrhaphy and appendectomy. 2 were kept in bed 16 and 23 days, respectively, because of extensive wound infection requiring irrigation with Dakin's solution, and neither has developed a hernia after 5 and 9 months the fifth patient was kept in bed 20 days to allow spontaneous healing of a previously made therapeutic fecal fistula.

7 One pulmonary infarction occurred and an other patient developed a streptococcus pneumonia and empyema subsequent to acute pyelonephritis. Both patients recovered.

8 Two hernias have appeared both subsequent to complete transverse division of all layers.

Mrs. H. S. aged 41 years, height, 5 feet 3 inches weight 175 pounds. Following simple cholecystectomy she vomited once 48 hours after operation, had considerable bloody drainage from her incision on the fifth day after operation. The drain was removed on the ninth day. She was allowed up in a chair on the tenth day. She vomited again the following day. Appendectomy was performed on the eighteenth day following which recovery was entirely uneventful except that bile drainage persisted until she was discharged from the hospital 28 days after cholecystectomy. One month after discharge a defect in the incised rectus could be felt but a definite bulging could not be demonstrated until 4 months after operation.

Mrs. J. K., aged 39 years height, 5 feet, 5 inches, weight, 205 pounds (cholecystectomy through vertical right rectus incision 7 years previously). She was nauseated after having taken 10 grains of sodium phenobarbital be-

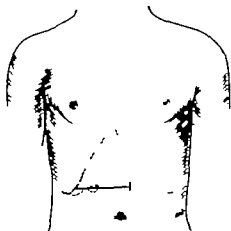


Fig. 2. A transverse skin scratch made across the liver border at the gall bladder level it connects a second scratch at the rib margin with a vertical third scratch 2 centimeters to left of midline.

fore going to operating room. After exploration of the common duct she vomited five times in first 24 hours and two to three times daily thereafter for 6 days, again on the ninth day. Penrose drain was removed on the ninth day. She was out of bed on the eleventh day and was discharged on seventeenth day. Monthly examination did not reveal hernia until 4 months later.

We think that the continued bile drainage (source unknown) and a small hemorrhage into the wound interfered with healing or led to too early absorption of sutures in the first case and that the continued vomiting in the second case was the important direct factor. We do not spare ourselves the reflection that better judgment would have been shown in postponing operation on the second patient who obviously had an idiosyncrasy for phenobarbital sodium as shown by the onset of nausea after the second 5 grain dose. Her final dose (pentobarbital) was of course, withheld. In neither case did gross infection of the wound occur. Both patients are now on weight reducing regimens and repair of the hernias should be far easier than in the case of vertical incisions.

TECHNIQUE OF INCISION

For the gall bladder and bile ducts the skin incision should be marked with a preliminary scratch as shown in Figure 2. The operating table is tilted so that the patient's head is higher than his feet. The costal margin, then the liver edge as determined by percussion are marked. The line of incision is then marked transversely from a point just to the left of the midline to the liver margin and continues laterally to the rib margin. When the abdomen is opened through this transverse line one will usually find the gall bladder just at this level and a little to the right of the middle of the incision.

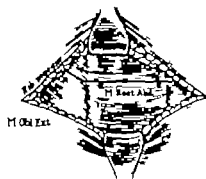


Fig. 3. Skin and fat have been retracted, the anterior rectus aponeurosis is split at the highest level between its fibers beginning at the midline and continuing diagonally upward across the rib margin.

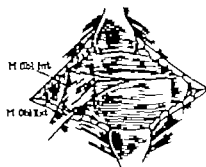


Fig. 4. The external oblique is retracted downward allowing the fibers of the internal oblique aponeurosis and muscle to be split in the direction of the arrow.

A definite routine should be followed in making the incision. After the skin and fat have been incised, the fat is brushed gently off the anterior fascial aponeurosis for a width of 2 centimeters. At the upper edge of this exposed area the anterior aponeurosis is opened from the midline to the lateral border of the rectus, and from this point the incision is continued laterally and upward between the fibers of the external oblique (Figure 3 shows more extensive dissection of fat from anterior aponeurosis for the sake of clarity). A narrow retractor is inserted into the lateral angle of the incision and pulls the lower border of the external oblique downward and laterally (Fig. 4) thus exposing the internal oblique and its fascia which are then split laterally from the edge of the rectus. At this point it will usually be found that the aponeurosis anterior to the rectus has retracted sufficiently to expose 2 centimeters of the muscle throughout its width; if it has not the lower flap of anterior aponeurosis should be dissected off to that extent. A haemostat is inserted under the rectus, lifting it gently and the muscle is divided along the lower edge of the exposed area, starting at the lateral border (Fig. 5). With retractors in the lateral angle of the incision drawing the external oblique downward and the internal oblique upward the transversalis muscle, fascia, and peritoneum are incised (Fig. 6) at the upper level of exposure, which is in the same plane as the incision through the anterior aponeurosis. The incision is carried to the linea alba. If opening of the common duct is not planned when exploration of the ducts is to be done the linea alba is divided.

SUMMARY

The drawings do not bring out the treatment of the rectus muscle described, but this is shown in

the diagram in Figure 6 in which it is seen that the anterior and posterior aponeurotic structures are incised at a higher level than the rectus muscle which, on closure, comes down like a tongue in a groove to a level 2 centimeters nearer the umbilicus, its line of division being covered anteriorly and posteriorly by intact fibrous structures rather than by suture lines. From the aspect of the suture lines in the fascial structures, this is a muscle-lined wound.

For most operations on the biliary tract we find that little extension of the fascial splits lateral to the outer border of the rectus is necessary. If more room is needed, particularly in operations on the ducts, the direction of the extension is always toward the midline and if further exposure for probing of the common duct is required the linea alba should be divided unhesitatingly. It has not yet been necessary to extend the incision for the purpose of routine inspection of the pylorus and duodenum during simple cholecystectomy. If still more exposure is needed after the linea alba is divided the anterior and posterior aponeuroses of the opposite side may be incised and the rectus retracted or divided. We made a left sided incision for splenectomy in the case of a ruptured spleen and found it so large that division of almost the entire width of the right rectus muscle was necessary to its delivery. The patient, a 68 year old woman, has a perfect abdominal wall 15 months after operation. The incision made on either side can be extended laterally so that the kidney is readily accessible to a transperitoneal operation. In order to accomplish this without restriction it is advisable and almost necessary to divide either the internal or the external oblique muscle in a direction that cross cuts some of its fibers. This is theoretically

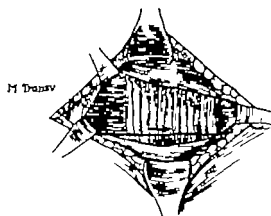


Fig. 5. The rectus muscle is exposed as far as possible by downward retraction of its coverings, then cross divided in the direction of the arrow at as low a level as possible.

undesirable but is probably of little practical consequence since the other two of the three flat muscles are split, thus leaving an abdominal wall sufficiently strong for all practical purposes.

After operations on the biliary tract we bring drains out obliquely through the split in the flat muscles at the lateral border of the incision. The tendency of these muscles to pull together very quickly blocks any opening made in them and an oblique drainage tract through the abdominal wall is probably far better than one piercing it directly like the spoke of a wheel radiating from the hub. Intra-abdominal pressure exerted radially in all directions must tend to cause the collapse of an oblique tract by forcing the inner against the outer wall.

We wish to warn the surgeon using this incision that he will probably find himself spending more time working on the abdominal wall than within it until he has familiarized himself with the procedure, such was our experience. But opening the abdomen becomes as easy in time, and quite as rapid by this method as through the Kammerer incision (paramedian incision retracting the rectus laterally from its sheath) closure is as quickly done in all cases and is often incomparably simpler and more certain. Exposure is vastly better than through the upper angle of a vertical incision; the small intestine shows little tendency to push out over the lower shelf of the wound; one pack usually sufficing to protect adjacent viscera from the operative field. These advantages during operation bear heavy dividends in the postoperative course of the patient, both immediately and remotely.

NOTE.—Since this article was submitted for publication two experiences with transverse incision are of interest. On May 23, 1933, the large postoperative hernia on Mrs.

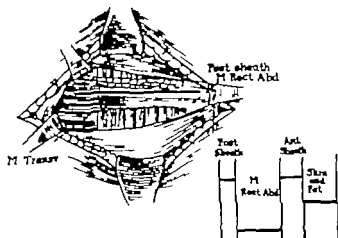


Fig. 6. The transversalis muscle and fascia are split between their fibers in a transverse direction at the same high level mentioned in connection with Figure 5 for the division of the anterior sponecostosis. (The diagram low right illustrates a staggered line of incision with muscle lined wound when closed.)

J. K. was very easily repaired, fascia lata suture from the patient's thigh being used to resuture strong anterior and posterior sponecostoses which were readily identified. Weight reduction from 305 to 172 pounds was brought about before repair was attempted. Mrs. T. B. had abdominal exploration for compensated cirrhosis of the liver associated with chronic cholecystitis on May 2, 1933. She developed ascites subsequent to operation and had almost continuous hematemesis until the twelfth postoperative day when suddenly evacuation took place through the incision, the transverse colon and omentum being extruded onto the skin. Immediate secondary suture of the incision was done under spinal anesthesia. No traces of catgut were found but there had been obvious partial healing. Resuture was accomplished with ease, and the suture held until the patient's death from liver failure a week later.

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DYSFUNCTIONAL UTERINE BLEEDING

RESULTS IN TREATMENT WITH EXTRACTS OF THE URINE OF PREGNANT WOMEN

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THE measures in common use for the treatment of dysfunctional uterine bleeding are usually rest, high calcium diet, injections of calcium or hemostatic serum, administration of preparations of ergot or corpus luteum, curettage, exposure to γ rays or the local application of radium. Not infrequently the disturbance will cease spontaneously. Occasionally these medical measures aid the patient over. Successful results have been reported with corpus luteum, although the preparations available for clinical use show no merit experimentally. Often simple curettage is sufficient. More often it is necessary to resort to more drastic procedures with γ rays or radium because the other methods fail.

Dysfunctional uterine bleeding is thought to be due to the same factors that probably take part in the bleeding of menstruation, namely some action of the anterior hypophysis on an endometrium that has been exposed to the secretion of the ripe ovarian follicle. Unlike menstruation, however, it is thought to be similar to the bleeding of monkeys, which frequently is not associated with ovulation, formation of a corpus luteum and proliferative changes in the endometrium.

The amenorrhea of pregnancy and possibly other amenorrheas are associated with persistence of a corpus luteum. Conversely the ovaries of patients with dysfunctional bleeding commonly fail to contain a corpus luteum. Menstruation has frequently been observed to start early following the operative removal of an active corpus luteum. Experimentally Smith and Engle have recently demonstrated in monkeys that a potent lipoidal extract of corpora lutea inhibited the bleeding that otherwise would have occurred consequent to the administration of hypophyseal extract and estrin followed by castration. The logical treatment then, of dysfunctional bleeding would seem to be with corpus luteum, were a preparation suitable for human use available. Since extracts of corpus luteum cannot yet be employed clinically, attention was turned to extracts of the urine of pregnant women (prolactin, antuitrin S, fol lutein, luteinizing hormone) which characteristically produce corpora lutea when injected into immature mice and rats and normal

rabbits. Because of their ability to luteinize the ovaries of experimental animals and because of their suitability for injection into humans, these extracts have been employed in the treatment of dysfunctional bleeding on the assumption that luteinization would take place and the flowing cease physiologically without recourse to the less rational methods mentioned. They have not been shown, however, to cause luteinization in humans in the amounts given and the actual mechanism of their therapeutic action still remains unsolved.

This report covers a total of 56 cases treated between January 1931 and August, 1932 of which 24 had had menorrhagia of 2 months' to 10 years' duration and 36 had had metrorrhagia of 9 days to 2 3/4 years' duration. Although the distinction between menorrhagia and metrorrhagia can at best be only rough, this division of the cases seemed worthwhile for the purpose of this study. All the cases received intragluteal injections of antuitrin S (Parke Davis & Co.) Until mid summer 1931 the material was labelled "luteinizing hormone—50 rat units per c.c.m." Since that time its potency has been labelled as 100 rat units per cubic centimeter. A rat unit is the smallest amount that will give discernible luteinization in the ovaries of immature rats by the Aschheim-Zondek technique. Due to the difficulties attending the extraction and purification of large quantities of this hormone and to deterioration the consignments have often not tested as high as designated potency. This factor combined with variable dosage, a necessary feature in testing a new substance clinically, has made it hard to evaluate results, and especially so in the type of disturbance herein concerned.

The chief obstacle to the administration of antuitrin S has been a reaction of more or less severity in the form of chills, headache, fainting, nausea, vomiting, and fever which has occurred within 12 hours following injection. This has followed in 21 per cent of the 412 injections given. The patients have also complained a little of local soreness. It has been impossible to predict whether or when these reactions will take place. Some lots of antuitrin S have given more reactions than others. The earliest batches not only were more potent in the laboratory but also

seemed more efficacious clinically and caused no reactions.

Menorrhagia. Twenty four patients complained of profuse and prolonged flowing at the time of menstruation. They were all between 17 and 42 years of age. Fourteen are considered cured in that their periods have been normal for 2 to 14 months following treatment. (Eleven have had normal periods for 5 to 14 months.) Eight of these had been ill for 2 months to 1 year. 4 had been troubled for 1 year (1 had pelvic inflammation) 1 had been handicapped 5 years and the last for 10 years. This last patient is 4 months pregnant, having had ten normal catamenias after treatment. Two years previously she had undergone operation for endometriosis. In 3 instances the menstruation after treatment started 5 days late. The dose of antuitrin S, both for these and the other cases in this report, varied from 2 to 9 injections of 2 to 10 cubic centimeters at a time over a period of 2 to 25 days. Most often the dose consisted of 4 to 6 injections of 5 to 10 cubic centimeters over 4 to 10 days.

Six patients of the menorrhagia group were temporarily benefited. The first (28 years old symptoms for 2 years) stopped flowing during the first course of injections but started again profusely 11 days later. The flowing ceased during a second course of injections and three normal catamenias have supervened. The second (37 years old symptoms for 1 year) had 2 series of injections with a normal period after each. She later had a recurrence and was treated with X rays. The third patient (32 years old, symptoms for 3 years following removal of a dermoid cyst of the right ovary, not relieved by curettage and resection of the left ovary for corpus luteum and retention cysts 2 months previously) had three normal menstruations after treatment, with a little intermenstrual staining. One series of injections stopped the bleeding of the fourth patient (17 years old profuse periods for 3 years since menarche) and 3 normal periods followed. During the next 3 months her menstruation was frequent, irregular, and prolonged. The fifth (35 years old profuse and prolonged catamenia for 6 months) had less flowing with one course of injections and then had two normal catamenias. A second course failed to control a recurrence. It has since been learned that she went to another clinic, where castration was performed. The sixth patient, a girl of 20 years, had had much abnormal flowing for 3 years during which time she had been curetted twice, had received a small dose of radium twice and treatment with X rays once. The first injections stopped her bleeding and she

had three uneventful catamenias thereafter. A second time antuitrin S seemed to control excessive bleeding and again the next period was normal. She then missed a period. At present recurrent flowing has just ceased again with treatment.

The hormone failed to be of any obvious benefit to 4 patients with menorrhagia of 3 months, 5 months, 1 year's and 5 years duration, respectively. No explanation for these failures can be found. The patients were apparently no different in respect to severity of flowing or to diagnosis from the helped cases and there was no noteworthy variation in the treatment.

Melorrhagia. Thirty two patients complained of prolonged bleeding. They were between 14 and 47 years of age. Fourteen stopped flowing coincident with treatment and have had no further trouble for 1 to 14 months. (Nine have been well for 6 to 14 months.) They are briefly summarized as follows:

1. Miss T. 21. Flowing 24 days. Catamenia regular for 8 months after injections.
2. Mrs. O.K. 44. Flowing for 3 months. Three normal periods have followed injections.
3. Mrs. B. 31. Profuse and irregular flowing for 2 years, 6 months. One year before, curettage and resection of ovary for endometrioma. After treatment she menstruated regularly for 10 months.
4. Mrs. B. 31. Profuse flowing for 10 days. Treatment was followed by two normal periods.
5. Mrs. R. 23. Flowing 9 months. Fourteen normal catamenias have occurred since injections.
6. Mrs. M. 43. Bleeding for 1 month. Then well for 10 months.
7. Mrs. R. 25. Flowing 25 days. For 5 months after treatment there was no flowing at all. Then there was a normal period. The next was missed and again there was a normal period. She was 5 months pregnant at the last report.
8. Mrs. B. 45. Flowing for 20 days. Regular catamenias for 12 months after the course of injections.
9. Mrs. S. 25. Flowing for 3 months—ceased with treatment and had not recurred 1 month later.
10. Mrs. R. 30. Profuse and irregular bleeding for 1 year, 4 months. No relief from a curettage. Regular catamenias for 4 months since treatment.
11. Miss Z. 20. Flowing for 9 months. Had had a curettage without relief then a curettage with removal of one ovary without benefit. She has now had 4 normal periods.
12. Mrs. A. 28. Flowing 21 days. After treatment her next two periods were very scant and 4 months of amenorrhea have since followed.
13. Miss C. 28. Flowing for 6 months, not relieved by curettage on two occasions. She has now had normal catamenias for one year.
14. Miss H. 32. Flowing 3 months. She has been well for 14 months since treatment.

The optimum dosage in this group was 20 to 40 cubic centimeters of antuitrin S given in 3 to 10 cubic centimeter amounts over a period of from 3 to 10 days.

Sixteen patients were benefited to a greater or less degree. With all of these bleeding stopped during or soon after injections. Nine had no further trouble for 3 to 14 months. (Seven were well for 3 to 14 months.) These 9 histories are briefly reviewed.

1. Mrs. F. 19. Flowing for 4 months, unrelieved by a curettage. With one series of injections the bleeding stopped. Two normal catamenias supervened. The next period was missed. Then there was constant staining for a month, not inhibited, and possibly stimulated, by a course of small doses of antuitrin S. Following another normal period, flowing began and did not cease until 3 months after a third treatment. For 3 months amenorrhea ensued. A fourth series of injections seemed to stop recurrent bleeding and there have since occurred two regular catamenias, each, however, of 5 weeks' duration.

Mrs. F. 26. Flowing 36 days. Relief coincident with injections, persisted for 7 months. Then prolonged slight staining ceased during another treatment.

3. Mrs. G. 37. Flowing for 3 months—ended after injections and did not recur until 7 months later.

4. Mrs. D. 47. Flowing 1 month. Four months of amenorrhea came after treatment and then very slight constant staining ensued.

5. Mrs. L. 30. Pulmonary tuberculosis. Flowing for 5 months, having had curettage and radium (50 milligrams for 8 hours) for the same complaint 7 months before. Normal periods occurred 1 1/2 months after a series of injections. After that for 3 months her periods have come every 3 weeks and have lasted 5 days.

6. Mrs. G. 38. Duration of flowing was 6 months. Two months before injections curettage and multiple small myomectomy had been performed with only slight relief. She was well for 3 months after one series. Then staining ceased during second series and three normal catamenias followed. During the next 9 months there was little staining between periods.

7. Mrs. H. 14. Flowing for 6 months, ceased with injections and 12 normal menstruations occurred. Recurrent flowing ceased with further injections, but staining started 10 days later. This disappeared after three 10 cubic centimeter injections of antuitrin S.

8. Mrs. P. 14. Bleeding for 30 days. After one course of injections 3 months of amenorrhea ensued and then months with only a catamenial stain. Recurrent flowing of 5 weeks' duration became, if anything, more profuse with injections (these again were small amounts). A third series of injections was given, the bleeding stopped and there has been no trouble for 1 month.

9. Mrs. P. 35. Flowing for 2 years, which stopped for the first time during treatment. The next normal period occurred during treatment. The next three catamenias were of 14, 8, and 30 days' duration, respectively. With another series the bleeding increased before ceasing. Three months of comparative relief followed, but then the trouble recurred as badly as ever and the patient had curettage and radium.

Of the 7 remaining patients in this benefited group, one has failed to report since her relief with treatment. The second (35 years old, flowing for 4 months unrelieved by curettage and conservative operation for pelvic inflammation) had a recurrence of bleeding 3 weeks after injections and has not reported since.

5. Mrs. M. 24. Flowing, of 7 months duration, ceased with injections and a normal period occurred. Seven profuse periods have since followed a second series.

4. Mrs. C. 40. Nine days of profuse bleeding which stopped with treatment but recurred 3 weeks later. At operation pelvic inflammation was found.

5. Mrs. B. 40. Flowing for 7 weeks. Bleeding decreased but did not stop with injections. At operation, performed within a week of treatment, pelvic inflammation was found. The ovaries showed no gross or microscopic change which could be attributed to antuitrin S, although four 10 cubic centimeter doses had been given (4000 rat units, according to designated potency).

6. Mrs. M. 30. Flowing for 6 weeks. Stopped with treatment and recurred 5 days later; then ceased within 3 days. The patient has now been well for one month.

7. Mrs. S. 5. Flowing for 3 months. Relieved by injections. A month later curettage and myomectomy were done at another hospital. Flowing recurred after operation and had lasted 4 months when the patient returned. Again it stopped coincident with injections. At the last report, 6 months later the patient stated that she had had a hysterectomy.

There were two complete failures. One of these patients had had radium (100 milligrams for 6 hours) a year before hormone treatment, which did not affect her recurrent flowing. The other continued to stain despite injections. Both ultimately had radium.

DEDUCTIONS

It is almost certain that some of the patients in this series would have improved without treatment. More of the others almost certainly would have come to operative procedures and irradiation. Cessation of flowing or normal menstruation followed treatment sufficiently often to be more than coincidental.

Antuitrin S has seemed to be more effective when administered while patients were flowing, e.g. in controlling rather than preventing menorrhagia. In a few instances, especially when small doses were given, it has seemed to cause a temporary increase in bleeding or a prolonged staining. On the other hand, amenorrhea and delayed menses occurred often enough in relation to treatment to seem caused by it.

The fact that it was of value in cases of endometriosis, 4 cases of pelvic inflammation and 2 of fibroids may be taken as evidence that bleeding in these conditions may be primarily dysfunctional and associated only indirectly with the diseases.

The employment of this hormone in bleeding cases presupposes as careful a diagnosis as possible, the most important feature of which is to rule out malignant pelvic disease.

LABORATORY DATA

In performing Aschheim-Zondek tests on urines from patients with dysfunctional flowing, we have

found that they often contain a hormone which produces follicle ripening in the ovaries of immature rats (the so called prolan A effect or anterior pituitary reaction I). Fluhmann has described this effect, using bloods of women with irregular profuse periods at the time of the menopause, and in younger patients with too profuse and too frequent menses. From 15 of the patients of the group herein reported morning urines were injected into immature rats in 6 cubic centimeter amounts. In all, 31 specimens were tested. Eighteen were from patients who were flowing at the time of collection and 14 of these gave positive prolan A effects. Of the 4 negative urines, 3 were collected after treatment had been started although the flowing had not ceased. From patients who were not flowing when the urine was collected on the other hand 11 out of 13 specimens were completely negative. These results suggest that the hypophyseal-like hormone found in the urines in these cases may be connected with the etiology of the condition. Further the findings intimate that antuitrin S may possibly have its beneficial effect through direct inhibition of this prolan A like hormone for in the case of 5 patients who were flowing and whose urines gave positive tests at the start of treatment, a disappearance of this substance from the urine was coincident with the cessation of symptoms after the course of injections. This finding has recently been duplicated in 12 more cases. As a control, tests were performed with urines from one woman who received no antuitrin S but whose flowing was temporarily stopped by curettage. They were positive for prolan A both before and after operation.

Novak and Hurd have already expressed the opinion that antuitrin S may have a direct effect on a 'bleeding factor' possibly of hypophyseal origin. Our early results support their opinion in that administration of antuitrin S was associated with the disappearance of a hypophyseal like

hormone from the urine. Preliminary experiments in which the hypophyses of spayed rats that had received antuitrin S were transplanted into immature females, have indicated a direct effect of this extract upon the anterior hypophysis. If it could be definitely shown that dysfunctional flowing is the result of abnormal hypophyseal activity and that antuitrin S directly inhibits or changes the abnormal factor there would be a logical basis for explaining the mechanism of the beneficial effect of this hormone without the necessity of considering the corpus luteum at all.

SUMMARY

The rationale for the employment of extracts of the urine of pregnant women in the treatment of uterine bleeding of dysfunctional origin has been presented. Antuitrin S, an extract of the urine of pregnant women, was administered to 56 patients with dysfunctional uterine bleeding with the following gross results: cured 28, benefited 22, unrelieved 6. The cessation of bleeding accompanied treatment so often and in many cases so rapidly as to leave little doubt of the specificity of the hormone, especially considering the variable potency of the preparations supplied. A limited number of laboratory findings have suggested a clue concerning the mechanism of this hormone's therapeutic action, namely, the possibility of a direct action on a hypophyseal hormone.

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TUMORS OF THE PAROTID REGION

STUDIES OF ONE HUNDRED AND THIRTY FIVE CASES

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THIS contribution is partly a continuation and partly an amplification of a paper entitled "Ninety Tumors of the Parotid Region in All of Which the Postoperative History was Traced," that made its appearance in the *American Journal of the Medical Sciences* December 1926. It is a continuation in that it tells what has happened to as many of those 90 cases as could be followed up during the 5 years that have since elapsed, and an amplification in that 45 additional cases have been studied and introduced in one way or another as what was known about them was found to be useful.

In each contribution I have made use of the expression "tumors of the parotid region" because experience early showed that few if any of the tumors are actually of the parotid gland most of them being *in* upon or adjacent to it. This is certainly true of the typical "mixed tumors" some of which are scarcely "adjacent" in the strict sense,—as in Singer's case, in which the tumor was in the external auditory meatus,—and doubtfully true of certain apparently carcinomatous tumors of the region, that leave one in doubt as to whether they began in the gland and invaded the adjacent tissues and skin, or in the skin and adjacent tissues and invaded the gland. Among the specimens called "carcinoma of the parotid" in hospital laboratories and surgical records, both have repeatedly been met.

In the earlier contribution the whole subject—probable origin, nature, location, structure appropriate treatment, and subsequent behavior—of these interesting tumors was covered, but always with particular stress upon the predominating group of "mixed tumors."

My personal observation and experience were supplemented by a review of the cases published in the literature, making total of 359. To them are now to be added 45 additional cases bringing the grand total of cases upon which the present contribution is based up to 404.

From the data formerly assembled it was concluded that the mixed tumors are peculiar highly variable neoplasms, that they are not always easy correctly to identify or classify and that they behave in a manner so erratic as to make correct

prognosis extremely difficult if not impossible. Additional data and experience have not modified those conclusions.

Surgeon friends who read the paper asked my opinion and advice about matters upon which I could not venture with confidence. It therefore seemed expedient to collect more cases, add to the data, and attempt new methods of analyzing and utilizing the information thus gained.

A persistent endeavor was made to follow-up the old cases for another 5 years, and to secure and follow up additional cases in which operation had been done 5 years or more ago. A few cases in which operation was but recently done have been used for the size and age data. Case numbers up to and including 90 belong to those reported in the earlier contribution.

It has been more easy to find and study sections of the tumors than to obtain the case histories. Sometimes no clinical notes were available, some times they were fragmentary in less than half of the cases were they at all complete. Some cases with limited data could only be used in certain tabulations, because some particular datum was useful and had to be omitted from others because it was lacking.

It must, therefore, be remembered that the cases mentioned in one relation are not necessarily the same cases mentioned in others.

With one or two exceptions, all of the patients had been operated upon, and specimens had been sent to the laboratory of a hospital for microscopic examination. My discovery of the tumors took place in the laboratories where I was permitted to study the microscopic slides, after which through the laboratory record, the case history, and the kindness of the surgeon, I finally traced the patient and learned the subsequent course of events.

The follow up many times failed, usually because of the death or removal of the patients to other cities. Of the many follow-up letters received from patients, not one expressed anything but appreciation of the fact that someone was interested in their progress, and some of the patients appeared to have been anticipating with pleasure the receipt of the semi-annual letter of inquiry.

On page 22 of the original paper, there is a tabulation of 44 cases of typical "non recurrent mixed tumors," and it will not be without interest to learn what has happened to them during an additional period of 5 years. Eight of the 44 patients—Cases 3, 8, 10, 11, 15, 37, 40, and 42—had already died of causes other than the tumor at the time the paper was published. In the years that have elapsed, 7 more patients have died. Case 2, patient free from recurrence 9 years, death from nephritis, Case 4, patient free from recurrence 11 years, death from pulmonary tuberculosis, Case 5, patient free from recurrence 16 years, death from cardiac failure, age 78 years, Case 9, patient free from recurrence 18 years, death from carcinoma of urinary bladder, Case 28 patient free from recurrence 16 years, death from apoplexy. Case 31, patient free from recurrence 7 years, death from pneumonia, Case 43, patient free from recurrence 3 years, cause of death not known, but death was not from the tumor.

During the same period 10 patients were, for various reasons, lost to the follow up but it is known that in Case 13, patient enjoyed freedom from recurrence for 9 years, in Case 17 for 2 years, in Case 21, for 11 years, in Case 22, for 1 year, in Case 24, for 5 years, in Case 26, for 9 years, in Case 33 for 4 years in Case 35, for 2 years in Case 38, for 7 years in Case 44, for 4 years.

There has been only one known case of recurrence, Case 16. The patient is now (1932) living and the small tumor is being treated with X rays. In his last letter he reported "doing well."

Of the original 44 cases, 18 patients are known to be living and well at the time of this writing. They were operated upon at periods varying from 5 to 21 years ago. Case 36 patient free from recurrence for 5 years, Case 32, for 7 years, Case 30, for 8 years. Case 41, for 8 years. Case 23 for 9 years, Case 34, for 9 years, Case 20, for 10 years. Case 25, for 10 years, Case 18, for 11 years,

TABLE I.—FOLLOW UP IN FORTY CASES

| Years of freedom from tumor | Living and well, case Nos. | Dead, case Nos. | Lost to the follow-up, case Nos. | Totals |
|-----------------------------|----------------------------|-----------------|----------------------------------|---------------|
| 3 | 36 37 30 | 3, 8 | 24 | 6 |
| 6 | 95 | 0 | 0 | |
| 7 | 32 94 | 11 31 | 38 | 5 |
| 8 | 30, 41 | 0 | | |
| 9 | 23, 34 | 2 | 3, 26 | 6 |
| 0 | 30, 38 | 0 | | 2 |
| 11 | 0 | 4 | 21 | 3 |
| 12 | 19 | 0 | 0 | 1 |
| 13 | 14, 39 | 0 | 0 | |
| 14 | 0 | 0 | 0 | |
| 15 | 103 | 0 | | 1 |
| 16 | 7 106 | 5, 38 | 0 | 4 |
| 17 | 27 39, 91 | 0 | 0 | 2 |
| 18 | 0 | 9 | 0 | |
| 19 | 1 | 0 | 0 | 2 |
| 20 | 0 | 0 | 0 | 0 |
| 1 | 6 | 0 | 0 | 1 |
| 22 | 0 | 0 | 0 | 0 |
| 23 | 0 | 0 | 0 | 0 |
| 24 | 103 | 0 | | — 40 cases |

Case 19 for 12 years, Case 14, for 13 years, Case 39 for 13 years, Case 7 for 16 years, Case 27, for 17 years, Case 29, for 17 years. Case 1, for 19 years. Case 12, for 19 years. Case 6, for 21 years. In addition there are some new cases. Case 99 free from recurrence for 5 years. Case 97 for 5 years. Case 95 for 6 years. Case 94, for 7 years. Case 105, for 15 years. Case 106, for 16 years. Case 91 for 17 years and Case 103 for 24 years.

TABLE II.—SMALL TUMORS—SMALLER THAN A WALNUT

| No. | Pre-operative duration, years | Postoperative freedom, years | Recurrence | Died | Living and well | Lost | Size of tumor | Remarks |
|-----|-------------------------------|------------------------------|------------|------|-----------------|------|---------------|--|
| 75 | 1½ | 8 | 0 | 0 | + | 0 | Peas | Microscopically suggested carcinoma |
| 46 | 3 | 9 | + | | + | 0 | Hasel-nut | |
| 33 | 0 | 4 | | | | + | Grape | |
| 61 | | 8 | 0 | | | + | Marble | |
| 37 | 4 | 7 | + | | + | | Almond | |
| 62 | 15 | 20 | | + | | | Hickory-nut | Died of acute indigestion suddenly |
| 84 | 5 | 3 | ? | + | | | Chestnut | Died of supposedly independent osteosarcoma of jaw |

TABLE III.—TUMORS OF ORDINARY SIZE—WALNUT TO LEMON SIZE, INCLUSIVE OF BOTH

| No. | Pre-operative duration | Post-operative freedom, years | Recurrence | Dead | Living and well | Lost | Size of tumor | Remarks |
|-----|------------------------|-------------------------------|------------|------|-----------------|------|---------------|---|
| 93 | 3 mos. | 5 | | | + | | Met | |
| 94 | ? | 20 | +++ | + | | | Met | Did not die of the tumor |
| | 5 yrs. | 17 | | | + | + | Walnut | |
| 7 | 10 yrs. | 10 | | | + | | Walnut | |
| 8 | 6 yrs. | 5 | | + | | | Walnut | Died of pulmonary tuberculosis |
| 11 | 5 yrs. | 7 | | + | | | Walnut | Died of heart disease |
| | 7 mo. | 8 | | | + | | Walnut | |
| 1 | 6 yrs. | 9 | | | + | | Walnut | |
| 41 | 20 yrs. | 5 | | | | + | Walnut | |
| 26 | 4(7) yrs. | 9 | | | | + | Walnut | |
| 97 | 8 yrs. | 17 | | | + | | Walnut | |
| 30 | 5 yrs. | 6 | | | + | | Walnut | |
| 34 | 1 yrs. | 9 | | | + | | Walnut | This tumor required 35 years to grow to potato, then 10 years grew to walnut size |
| 25 | 6 yrs. | ? | ? | ? | ? | + | Walnut | |
| 43 | 43 yrs. | ? | ? | + | | | Walnut | Cause of death not known |
| 47 | 20 yrs. | 16 | + | + | | | Walnut | Died of pneumonia at 82 years of age |
| 48 | 5 yrs. | | +++ | | + | | Walnut | |
| 25 | 6 yrs. | | | + | | | Walnut | Died of kidney disease |
| 66 | 1 yrs. | 5 | ? | ? | ? | + | Walnut | |
| 69 | 6 yrs. | | | | + | | Ovary | |
| 81 | mo. | | + | + | | | Walnut | Unimproved by operation, had recurrence, died of tumor which may have been cancer |
| 97 | 1 mos. | 5 | | | + | | Walnut | |
| | 11 yrs. | ? | ? | ? | ? | + | Walnut | |
| | 7 mo. | ? | ? | ? | ? | + | Walnut | |
| 5 | 1 mos. | | | + | + | | Pine | Died of acute appendicitis |
| 30 | 15 | 5 | | | + | | Pine | |
| 40 | 8 mos. | | | + | | | Pine | Died immediately after rat operation |
| 44 | 7 | 4 | | ? | ? | + | Pine | |
| 48 | 10 yrs. | 6 | + | | + | | Pine | |
| 61 | 11 yrs. | 0 | | | | + | Pine | |
| 65 | 6 yrs. | 6 | | | | + | Pine | |
| 66 | 5 yrs. | | | | | + | Pine | |
| | 8 yrs. | 9 | | + | | | Egg | Died of kidney disease |
| 10 | 7 yrs. | ? | ? | + | + | | Egg | Died of arteriosclerosis in 3 months |
| 5 | 1 yrs. | 3 | | + | | | Egg | Cause of death unknown—not the tumor |
| 3 | 7 yrs. | ? | | | + | | Egg | |
| 41 | 20 yrs. | | + | | | + | Egg | |
| 52 | 6 yrs. | ? | ++ | | | + | Egg | |
| 71 | 3 yrs. | 9 | | + | | | Egg | Died of pulmonary tuberculosis |
| 74 | 7 | 5 | | | + | | Egg | |
| 76 | 3 yrs. | 8 | + | | + | | Egg | |

TABLE III.—TUMORS OF ORDINARY SIZE—WALNUT TO LEMON SIZE, INCLUSIVE OF BOTH—
Continued

| No. | Pre-operative duration | Postoperative freedom, years | Recurrence | Died | Living and well | Lost | Size of tumor | Remarks |
|-----|------------------------|------------------------------|------------|------|-----------------|------|---------------|--|
| 77 | 4 mos. | — | ++++ | + | o | o | Egg | Died of the tumor perhaps cancer |
| 10 | 6 yrs. | ? | ? | ? | ? | + | Egg | |
| 93 | 4-6 yrs. | ? | o | + | o | o | Thumb | Accidentally killed |
| 30 | 7 yrs. | 14 | o | o | + | o | Seckel pear | |
| 71 | 30 yrs. | 9 | | o | o | + | Lemon | |
| 82 | 10 yrs. | 5 | ? | ? | ? | + | Lemon | |
| 21 | 30 yrs. | 7 | | + | o | o | Lemon | Died of pneumonia |
| 67 | 6 mos. | 15 | o | o | + | o | Lemon | |
| 80 | 1 yr. | — | + | + | o | o | Lemon | Died in a year of the tumor perhaps cancer |
| 87 | 8 mos. | 11 | + | + | o | o | Lemon | Died of the tumor |

TABLE IV.—LARGE TUMORS—THOSE OF SIZES LARGER THAN A LEMON

| No. | Pre-operative duration | Post-operative freedom, years | Recurrence | Died | Living and well | Lost | Size of tumor | Remarks |
|-----|------------------------|-------------------------------|------------|------|-----------------|------|---------------|--|
| 9 | 30 | 18 | o | + | o | o | Apple | Died of carcinoma of the urinary bladder |
| 14 | 25 | 13 | o | o | + | o | Goose egg | |
| 71 | many | 2 | o | + | o | o | Goose egg | Death unrelated to the tumor |
| 30 | 10-5 | 10 | o | o | + | o | Orange | |
| 41 | 3 | 3 | o | + | o | o | Orange | Died of diabetes, no recurrence |
| 70 | 2 | 5 1/4 | o | o | o | + | Orange | |
| 83 | 15 | — | + | + | — | o | Orange | Died of the tumor in 2 years |
| 36 | 7 | 5 | o | o | + | o | Grapefruit | |
| 37 | 10 | — | — | — | — | — | Grapefruit | Died without treatment |
| 35 | 18 | 11 | o | + | o | o | Grapefruit | Death unrelated to the tumor |
| 95 | 20 | 7 | o | | + | o | Grapefruit | |
| 55 | 20 | — | + | + | o | o | Two fists | Died of the tumor |
| 100 | 20 | — | o | + | o | o | Human head | Died at the operation |

Table I shows 40 cases old and new, living, dead, and lost, in which the patients are known to have enjoyed freedom from the tumor for 5 years or longer after operation.

GROWTH OF THE TUMORS

At this point it becomes desirable to place before the reader certain facts regarding the growth rate of mixed tumors that form the basis of certain important conclusions, and to that end beg the reader to refer to Tables II, III, and IV. In all but 2 or 3 cases, in which metric measurements of length, breadth and thickness were mentioned the tumors have been described in the protocols as the "size of a walnut," etc. When all of the

standards of comparison were listed no less than 16 sizes, beginning with a "pea" and ending with a "human head" were found to have been employed. It was impossible to take notice of all of these minute divisions, so the tumors have been divided into three principal divisions (I) small tumors (smaller than a walnut), (II) ordinary sized tumors (from a walnut to a lemon, inclusive), (III) large tumors (larger than a lemon).

If this tabulation (Tables II, III, IV) be examined, the tumors will be found to have a fairly regular average growth rate. That is to say the small tumors had an average pre-operative duration of about 5 years, the ordinary sized tumors of about 10 years, and the large tumors of about

TABLE V.—COMPARISON OF SIZE AND DURATION

| Size | Tumors | Average duration, years |
|---------------------------------|--------|-------------------------|
| 1. Smaller than walnut | 7 | 5 |
| 2. Walnut | 23 | 10 |
| 3. Plum | 8 | 9 |
| 4. Egg | 4 | 6 |
| 5. Lemon | 6 | 8 |
| 6. Apple, goose egg, and orange | 7 | 18 |
| 7. Grapefruit or larger | 6 | 20 |

20 years. If we divide the tumors into a greater number of sizes, the occasional variations in growth rapidly accidentally intensified in some particular group result in a slight disorder yet the average is pretty well maintained (Table V).

Perhaps the discrepancies in Table V depend upon certain of the tumors differing in kind from the others, the chief differences being very short pre-operative duration (a year or less) recurrence, and death of the patient. If such cases be eliminated, the results concerned with mixed tumors alone show growth to be progressive and regular except for the group of egg size.

TREATMENT

The time-honored treatment of tumors of the parotid region is surgical excision, and is still generally practiced, though irradiation is being tried in an increasing number of cases, and in many circles seems to be meeting with a cordial reception in spite of the fact that the structure of the tumor really suggests a very unpromising field for success.

The value of any treatment can be estimated only by the results obtained, and the statistics published are in complete accord in finding that the excision of these tumors falls in from 25 to 30 per cent of the cases. But notwithstanding this high percentage of failures, and, perhaps on account of them, the method is not only continued, but patients are urged to undergo the operation at the earliest possible moment, first, because sooner or later it will be inevitable second, because a small tumor is supposed to be more easily and certainly eradicated than a large one and third, because if neglected the tumor may change from a benign to a malignant course. It may be well to consider to what extent these opinions are justified.

1. *What will happen to the patient if no treatment be instituted?* If a typical mixed tumor, as identified by its years of duration, its location, its circumscription, and its histological structure, gradual growth through many subsequent years is a fairly safe prognosis. There is no hurry and

TABLE VI.—REVISED COMPARISON OF SIZE AND DURATION

| Size | Tumors | Average duration, years |
|-----------------------------|--------|-------------------------|
| 1. Smaller than walnut | 7 | 5 |
| 2. Walnut | 20 | 12 |
| 3. Plum | 5 | 5 |
| 4. Egg | 7 | 7 |
| 5. Lemon | 3 | 17 |
| 6. Apple, goose egg, orange | 7 | 18 |
| 7. Grapefruit or larger | 6 | 20 |

relief from the deformity is the chief incentive to do something.

II *What will happen as the result of treatment?*
Irradiation. What we know may be of little value because not enough treated patients have been observed long enough to permit satisfactory comparison with the older and more widely practiced method of surgical excision.

Case 34. The tumor was operatively removed and X ray treatments subsequently applied. At the end of 10 years there had been no recurrence, but that is what commonly happens without such treatments.

Case 46. The tumor, operatively removed, recurred in 9 years and 6 months. It was given X-ray treatments, and for 7 years has remained unchanged in size. That also sometimes happens, so it does not prove that the irradiation was useful.

Case 16. The tumor operatively removed, recurred after 6 years and 6 months. It was given X-ray treatments, and there has been no return in two years, which is too short a time to mean anything.

Case 85. After three operative removals in 1905, 1915 and 1923 seven X-ray treatments were given without effect the tumor continued to grow and finally caused death.

Case 88. After surgical removal in 1909 and 1914 and repeated X-ray treatments, the patient not having improved, died of the tumor.

Case 20. After surgical removal of the tumor in 1915 and 1922 the patient was given intensive X ray treatments. There has been no return of the tumor (1932). Other tumors, twice removed, have also failed to return for periods of 9 years, where no X-ray treatments were given.

From this amount of evidence it is difficult to conclude that any benefit to the patients accrued from the irradiation.

Surgical excision. It is, of course, impossible for the pathologist to know about the conversations that go on between the patient with a tumor and the surgeon whose advice is sought, but the usual result is an operation at which the tumor is removed. Presumably the patient desires to be rid of an increasing physical deformity and the surgeon to free him of such future trouble as the presence of the tumor may entail. After this radical treatment, some 70 per cent of the patients with tumors are never seen again. But 30 per cent of the tumors recur.

On page 24 of the earlier paper, there were tabulated 19 cases of mixed tumors that had recurred at that time, and it may be of interest to know what has since happened to them.

In the 3 cases—50, 54, and 58—death occurred from causes other than the tumors before the publication of the paper.

In the 3 cases—death occurred since publication of the paper from causes other than the tumor—in Case 56 from abdominal carcinoma not connected with the parotid tumor and 5 years after its removal and with no recurrence Case 62 from "acute indigestion," without any new recurrence in 30 years Case 47 from cardiac failure at 78 years of age, and after 16 years of complete freedom from the tumor.

Three cases are known to be living and without recurrences at present. Case 48. Case 49, patient has had 15 years of freedom since the third operation. Case 61, patient has had 10 years of freedom since the second operation.

One case—46—the tumor was first removed in 1914, there was a recurrence in 1924, and although energetically treated with X rays, the "lump remains."

Two cases—55 and 59—patients have died of the tumors after repeated recurrences.

Seven cases—45, 51, 53, 57, 60 and 63—have been lost to the follow up.

The urgency of the operation. Should any patients be advised to undergo immediate operation? Before this question can be answered it is necessary to recall that there are certainly considerable differences among the tumors, the most notable being in the length of pre-operative duration, those known to have existed for years usually showing a microscopic structure typical of "mixed tumors," those the duration of which is expressed in months an atypical structure more or less closely resembling carcinoma.

a. *Slowly growing tumors.* Let it be supposed that the tumor is small, has been recognized by the patient for 3 or 4 years. As has been shown in the tabulation given, such a tumor usually continues to grow slowly, doubling its size every 5 years or so. There need, therefore, ordinarily, be no hurry in removing it in so far as its growth is concerned. On the contrary, there may be excellent reasons for not disturbing it.

One of the most distressing accidents that may result from the operation is the destruction of the facial nerve that lies in close juxtaposition to many of the tumors. Two cases among personal acquaintances illustrate this complication.

Miss C. — a charming spinster good to look at and delightful to converse with, discovered a "lump" behind the angle of the jaw. It was no larger than an almond, and could only be felt, not seen. Alarmed at the thought that it was a tumor she sought advice, and learning that the operation for the removal would be perfectly easy and simple, permitted its performance. She recovered from the anesthetic to find the whole right side of the face hopelessly paralyzed, and ectropion soon occurred. Subsequent "lifting of the face" was twice tried with little improvement,

and for 5 or more years she has been distressed at what she sees in her mirror and her friends at her changed and unsightly appearance. Had the operation been deferred a swelling might now be apparent where the tumor was situated, but her face would retain its vivacious and cheerful expression, and she would have enjoyed years of happiness instead of mental anguish.

Mr. J. M. — Case 47—had a small cyst removed from the parotid region. It recurred almost at once but grew so slowly that at the end of 30 years it was only of walnut size. It caused what he considered to be an unsightly swelling and after consultation it was operatively removed. He lived 16 years with facial palsy and ectropion before he died suddenly aged 78 years.

Six of the patients of this series (45, 48, 56, 103, 47, and 83) are known to have suffered in this way, only one case, 83, having made a good recovery. A "lump" upon the face would be vastly preferable to the distress of facial palsy with ectropion.

A second accident, salivary fistula, is rare, and only one of the patients, Case 2, complained about it, and about an operation for its cure having failed.

Is it not important to operate when the tumor is small because of the greater ease of operation and the complete removal of the tumor more certain? In this case it would seem as though the chief criterion of success must be the prevention of recurrence.

Among the tumors of this series concerning which the data are available recurrences occurred in 30 per cent, fatality in 13 per cent among the clinically and microscopically "mixed tumors," the recurrences were 25 per cent and the fatalities only 3 per cent.

Curiously enough recurrences are more frequent when the tumor is removed while small. In the tabulation showing the tumors arranged according to size it will be found that in Group I, tumors smaller than a walnut there are 7 of which 2 recurred, 28.5 per cent, in Group II, tumors of ordinary size, there are 51, of which 11 recurred 21.5 per cent, and in Group III, large tumors there are 13 of which 2 recurred 16.1 per cent. Thus it seems that the smaller the tumors are, the more apt they are to recur.

If it be objected that this makes no allowance for the probable differences in the nature of the tumors, it must be remembered that it is impossible accurately to determine the nature of the tumor before operation, if it can be done at any time.

But assuming that a short pre-operative duration and an ambiguous microscopic appearance characterize tumors to be regarded as malignant, and eliminating them, the ratio will stand thus: Group I, small tumors, 7 with 2 recurrences, 28.5

TABLE VII.—RELATION OF GROWTH TO MALIGNANCY—OPERATION IN ALL CASES

| Case | Sex | Duration, mos. | Microscopy | Outcome |
|------|--------|----------------|---------------|---|
| 97 | Male | 1 | Mixed tumor | Living and well 2 yrs. |
| 85 | Female | | Carcinoma (?) | Recurrent, continued growth, killed |
| 8 | Female | 2 | Mixed tumor | No recurrence in 4 yrs., died of appendicitis |
| 44 | Female | 2.5 | Mixed tumor | No recurrence in 4 yrs. lost |
| 74 | Female | 3.5 | Carcinoma (?) | No recurrence, 3 yrs. living and well |
| 77 | Female | 4 | Carcinoma (?) | Four recurrences caused death |
| 67 | Female | 6 | Benign (?) | No recurrence in 3 yrs. living and well |
| 80 | Female | | Carcinoma (?) | Died of carcinoma within year |
| 82 | Female | 8 | Carcinoma (?) | Said to have lived 3 yrs. before dying of tumor |

per cent Group II, average tumors, 44 with 7 recurrences, 15.83 per cent Group III, large tumors, 13 with 2 recurrences, 16.1 per cent, so that the same holds true—the highest percentage of recurrence results from operations upon the smaller tumors.

b. *Rapidly growing tumors.* Let it be supposed that the tumor small or of ordinary size, has appeared and grown to its present dimensions in a year or less, should it not then be promptly removed? It is such tumors that give the greatest anxiety to surgeons, who always suspect them of malignant disposition. What is the evidence that rapidity of growth is indicative of malignant tendency? Table VII may give some information on the subject. It contains all of the tumors of rapid growth, and so all those the surgeon would certainly have recommended for immediate operation. In how far would he have been correct?

Here are 9 cases in all of which the growth was alleged to be of less than a year in duration and hence under suspicion of malignancy. Of these, 5 behaved as benign tumors, although 3 had a histological structure apparently inconsistent with such a prognosis. It is most interesting to see that the growths in Cases 97, 18, 44, 74 and 67 that should ordinarily have taken 10 years to reach the sizes at which they came to operation grew to those sizes in an average period of $7\frac{1}{2}$ months, without any evidence of malignancy. Therefore as less than half of these rapidly growing tumors proved to be malignant, rapidity of growth is an insecure guide to follow.

c. *Are patients with apparently malignant growths benefited by operation?* In solving this problem the great difficulty lies in reaching a conclusion as to what is meant by the term malignancy as it is applied to these tumors. The microscope, ordinarily the authority on this subject, fails. Thus

Case 67. The growth appeared to be microscopically a lymphosarcoma, but the patient was alive, well, and without recurrence 1 year after one operation.

Case 69. The growth also appeared to be a lymphosarcoma, but the patient was alive, well, and without recurrence 10 years after one operation.

Case 72. The growth, when examined microscopically appeared carcinomatous, but the patient lived 16 years, with no recurrence after one operation, to die of cirrhosis of the liver.

Case 73. The growth appeared "carcinomatous," but the patient lived 9 years, with no recurrence after one operation, to die of tuberculosis of the lungs.

Case 74. The growth appeared carcinomatous, but the patient lived 15 years, with no recurrence after one operation, and was then lost.

Case 75. The growth appeared "carcinomatous," but the patient lived 8 years, with no recurrence after one operation, and was well in 1913.

Case 76. The growth appeared to be carcinomatous, but the patient lived 8 years, with no further recurrence, after a second operation and is living and well in 1913.

Case 82. The growth appeared to be carcinomatous, but the patient lived 3 years, with no further recurrence, after a second operation and is living and well in 1913.

Seven cases of apparently malignant tumors cured by one or two operations is a high rate of cures and it may be that the surgeons are to be congratulated upon their success, but suspicion must rest upon the results because of the uncertainty of the microscopic diagnosis.

In 13 other cases, microscopically resembling carcinomata the patients have all died of their tumors, under conditions and in a period consistent with that diagnosis. This gives a total of 21 cases of seemingly malignant tumors, of which 40 per cent did not and 60 per cent did, behave as such.

From an examination of the fatal cases, one cannot escape the conviction that the benefits of operation seem to be very small (Table VIII), as in most of the cases the tumor progressed promptly to its fatal termination.

But this subject must not be concluded without mention of 3 cases in which the surgeons take

TABLE VIII.—RESULTS IN THIRTEEN CASES MICROSCOPICALLY RESEMBLING CARCINOMA

| Case | Size | Duration | Treatment | Result |
|------|-----------|----------|------------------------|---|
| 81 | Walnut | 1 mo. | Excision | Died of tumor in a little less than 3 yrs. |
| 40 | Plum | 15 mos. | Excision | Died immediately after operation |
| 77 | Egg | 4 mos. | Excision | Recurred 3 times; 3 later operations, died in 3 yrs. 1 month. |
| 80 | Lemon | 18 mos. | Excision | Died of the tumor in a year—general carcinoma tests |
| 87 | Lemon | 8 mos. | Excision | Died of the tumor in 3 yrs. |
| 33 | Two fists | 30 yrs. | Excision | Died of the tumor in 8 yrs. |
| 55 | Orange | 13 yrs. | Excision and X-rays | Died of the tumor in 3 yrs. |
| 73 | ? | 6 mos. | Excision | Died of the tumor in 7 yrs. |
| 79 | ? | 13 mos. | Excision | Died of the tumor within yr |
| 82 | ? | 13 mos. | Excision | Never improved, died of the tumor |
| 84 | ? | 3 yrs. | Excision | Died of the tumor in a few months |
| 86 | ? | 3 yrs. | Excision 1924 and 1936 | Died of the tumor in 1936 or 1937 |
| 89 | ? | ? | Excision 1909 | Died of the tumor in less than 3 yrs. |

great pride, and to which they point as triumphs of surgery

Case 76. The tumor in 3 years grew to the size of an egg and was operated upon in 1920 and again, for recurrence, in 1924. The tissue removed had a histological appearance so similar to carcinoma that it was unhesitatingly so classified. The patient, however, is living and well (1933) 8 years later.

Case 83. A walnut-sized tumor was removed in 1917 followed by operations for the removal of recurrences in 1919, 1920, and 1923. The tumor was similarly unhesitatingly classified as a carcinoma, but the patient was living and well, and working as a truck-driver in 1933, 9 years later.

Do these cases indicate malignant tumors cured, will they return later, or was the microscopic appearance deceptive and the tumors after all of low grade malignancy? Perhaps future observation will tell.

Is operation really a useful procedure? If, as has been shown, operation is not urgent because the tumors usually have a regular and slow rate of growth if it is more difficult successfully to eradicate them when small than when large. If there is always danger of damaging the facial nerve and so occasioning greater deformity and misery than the tumor itself entails. If rapid growth is no index of malignancy, if the microscopic appearance of the excised tissue offers no guarantee of exemption from recurrence, and in many cases is uncertain as to malignancy and prognosis and if the benefit conferred by excision in the cases that turn out to be malignant is very slight, why should the surgical excision of these tumors be practiced? Only because it is generally supposed that the 70 per cent of cases in which no subsequent symptoms are manifested, are cured. But here, again,

arises a great uncertainty. Who is cured and when? For example, in Case 48 there was a recurrence after 6 years of freedom from the tumor, in Case 52, after 7 years of freedom, in Case 46 after 9 years of freedom, in Case 49 there were three recurrences after 11 years of freedom in Case 45, there was a recurrence after 13 years of freedom, in Case 47, after 16 years of freedom in Case 50, after 30 years of freedom.

If any one of these patients had died during the period of freedom, it would have been supposed that the disease was cured. But not so, it recurred. The discovery of the long interval of freedom after which recurrence might occur was the chief reason for continuing to study the tumor in preparation for the present contribution.

If the tabulation on one of the earlier pages, showing 19 cases carefully followed, and known to be living and well at the present time be examined, it will be noted that not one of them has outlived the possible period of recurrence as indicated.

Recurrence is the horrible menace of the parotid tumors. There is no certainty of exemption from recurrence, and once it happens, the chances seem to be that it will be repeated again and again. There are several theories to explain recurrence.

1. In addition to the tumor that the surgeon sees and carefully removes, there may be other and smaller ones that he does not see (multicentric growth) and that later develop to noticeable size. Under these circumstances the recurrence can be regarded as an entirely different tumor, and may not make its appearance for a long time as shown in Table IX.

TABLE IX.—RECURRENCES

| Case | First operation | Second operation | Third operation | Free intervals in years | Termination |
|------|-----------------|------------------|-----------------|-------------------------|---|
| 46 | 1914 | 1914 | | 10 | Living with the recurrence in 1924 |
| 61 | 1899 | 1900 | | 5 | Died without further recurrence in 1904, 20 yrs |
| 45 | 1905 | 1910 | | 5 | Died without recurrence in 1912, 12 yrs |
| 52 | 1910 | 1911 | | | Died without recurrence in 1914, 7 yrs |
| 47 | 1886 | 1916 | | 30 | Died without recurrence in 1917, 16 yrs |
| 58 | 1911 | 1912 | | | Died without recurrence in 1916, 6 yrs |
| 6 | 1915 | 9 | | 7 | Has been well for 8 yrs no recurrence |
| 48 | 1913 | 1915 | | | Has been well for 7 yrs no recurrence |
| 49 | 1904 | 91 | 9 5 | 1. 4 | Has lived 7 yrs no recurrence |
| 50 | 1886 | 1901 | 91 | 15 | Died 19 yrs. after the third operation, no recurrence |
| 56 | 1914 | 1919 | 1927 | 5, 8 | Living 1923, 5 yrs without recurrence |

It seems unlikely that recurrences at such wide intervals can be other than new tumors arising in the same manner as the primary tumor did.

3. For any of several reasons the surgeon may not be able to effect a complete eradication of the tumor and, knowingly or unknowingly leaves fragments that continue to grow and perhaps to invade. The following cases may be explained in this way

Case 50. First operation 9 5, second (9 months later) 9 5, third 1910—died of the tumor in 1932

Case 5. First operation 9 0, second 9 2, third 9 8, fourth 1914, fifth 1920—has since lived 8 years without recurrence

3. If the capsule of the tumor be opened during the operation, tumor cells may be transplanted and produce recurrence. This theory is supported by the successful cultivation of "mixed tumor tissue *in vitro*" Prompt, unencapsulated and infiltrative types of growth might be expected under these circumstances, and it may be that some of the carcinoma like tumors thus arise. If the following ambiguous tumors were members of the mixed tumor class, the implantation of their cells at the time of operation may account for what subsequently happened

Case 77. This tumor recurred 4 times in 6 months and terminated fatally

Case 81. The operation for removal failed, the tumor continued to grow and was fatal

Case 82. The patient never improved after the operation and died of the tumor

Case 53. After operation the tumor began to grow again, at once. (This was one of the hard cartilaginous varieties of "mixed tumor")

The escape of the tumor tissue from its capsule through incision for biopsy examination or at surgical excision appears to modify the type of growth in some cases by permitting infiltration of

the surrounding tissues. Such a change seemed to have taken place in Case 59. The patient had a tumor of 5 years' duration which was removed in 1915 and proved, upon microscopic examination to be a mixed tumor. It was described by the pathologist to the hospital as a "fibro-chondrosarcoma of the parotid." In 9 months there was a recurrence that was removed in 1926. In 1928 I examined this patient and found a second recurrence of hen's egg size, most of the surface of which was well defined though at one or two points it seemed vaguely to infiltrate the surrounding tissues that were swollen and firm like carcinoma. Another excision was performed, and though parts of the surface were found to be covered with a capsule, the uncovered portions infiltrated the adjacent tissues. With the excised tumor there came to the laboratory a rounded body supposed to be an invaded lymph node. It was, however, a separate small tumor mass with nothing to suggest that it had ever been a lymph node. The patient died, in 1931 of the tumor which had not given metastasis so far as could be determined. Unfortunately the description of what happened is vague—"The tumor grew quite large, invaded the orbit so that the eye protruded, and she died when it went to her brain."

Do mixed tumors become malignant in the sense of transforming into sarcomata or carcinomata? In the former paper this question was considered at considerable length. The tumors supposed to have become sarcomatous did not behave as sarcomata usually do or those supposed to have become carcinomatous as carcinomata usually do, the difference in behavior being the extreme rarity of metastases.

It is very difficult to overcome the prevalent disposition to classify all malignant tumors as

members of one or the other of the time-honored groups—carcinoma or sarcoma. There are certainly malignant tumors, non metastatic (gliomata) and metastatic (melanomata) that cannot be so classified but are a law unto themselves, and perhaps these 'mixed tumors' belong in a category of their own.

When it is considered that no one who has had one of these tumors can ever be regarded as exempt from the danger of recurrence, that a tumor that had occasioned no other disturbance than that caused by its physical bulk (size of an olive) for as long as 30 years (Case 50) when excised, was followed by a recurrence that grew rapidly to the size of an orange that in Case 88 a tumor that had grown for 15 years to reach the size of an orange and in Case 55 one that had required 20 years to reach the size of two fists when operatively meddled with assumed so violent a course of recurrence, increase in volume, compression and obstruction of adjacent passages, ulceration, and necrosis as to prove fatal in 2 years or so, that these tumors if injured, are apt to undergo necrosis, ulceration, hemorrhage and infection from which there is no recovery, and that in the great majority of cases the ill effects are entirely limited to the region in which they grow, it seems not only reasonable to consider them malignant, but as characterized by a peculiar and individual type of malignancy quite different from that of more commonplace growths.

Mixed tumors of the parotid do not, therefore, become malignant, rather they *are* malignant, though this is true in varying degrees in different cases.

If this view be adopted it will be easy to understand Kornblith's case of a mixed tumor of the submaxillary gland, excised and twice recurrent, that was followed 3 years later by the appearance of metastatic mixed tumors of histological structure exactly like the primary tumor in the lungs and many other organs. This tumor certainly did not become malignant, it was so. Neither did it undergo sarcomatous or carcinomatous 'degeneration'—it was and remained a 'mixed tumor' of the cylindromatous type. The same is true of the only case of metastasis that has come under my observation (Case 115), that of a parotid region tumor with an enlarged lymph node in the neck. Microscopic examination of the lymph node showed a nodule of mixed tumor—not of carcinoma.

Does the age at which the tumors first appear have any bearing on their subsequent behavior? The available data upon this subject are shown in the following outline

I. *Non-recurrent mixed tumors*

40 cases average 34.5 years of age at first appearance of the tumor—
Minimum age—16 years
Maximum age—67 years

II. *Recurrent mixed tumors*

10 cases average 30 years of age at first appearance of the tumor—
Minimum age—14 years
Maximum age—44 years

III. *Repeatedly recurrent mixed tumors*

5 cases average 21.9 years of age at the first appearance of the tumor—
Minimum age—3 years
Maximum age—50 years

IV. *Fatal cases of all kinds*

11 cases average 52 years of age at the first appearance of the tumor—
Minimum age—26 years
Maximum age—75 years

At first this tabulation appears to be quite intriguing in the first three groups it seems that the earlier the tumor appears, the more trouble it is likely to give. But the figures may be of no importance as the extremes in each group show great divergence, and Group IV with the greatest age of primary appearance and which, therefore, should be the least distressing, is made up of repeatedly recurrent fatal tumors. But the number of tumors upon which the computation is based is not only too small to give accurate information but the variability of the tumors themselves probably makes the computation valueless. For example if, because a patient's age is 42 it were supposed that his tumor would probably prove malignant and fatal, the probability would be completely offset by the fact that in Group I in 12 of 40 cases the patients are above 40 years old. If, on the other hand the patient being only 22 it were inferred that the tumor would probably recur again and again, it would be made equally improbable because in the same Group I in 6 out of 40 cases the patients are less than 22 years of age.

Is there any means by which a prognosis can be reached? If it be admitted that all mixed tumors are potentially malignant as has been suggested, it is not with reference to their benignancy or malignancy that the prognosis is desired, but with reference to the *probable degree of the malignancy* in each particular case. This matter was considered 5 years ago and the conclusion reached that if the tumor has reached a size bringing the patient to operation in a year or less, and if the tissue removed appears 'carcinomatous' the prognosis is ominous.

CONCLUSIONS

1. Tumors of the parotid region, unlike most other tumors, vary greatly in histological structure and clinical manifestation, without any constant correspondence of the two by which accurate diagnoses and prognoses can be arrived at.

2. Tumors of the microscopic structure supposed to be typical of "mixed tumor" frequently cause death after repeated recurrence and infiltrative growth, but very rarely with metastasis to distant organs.

3. Tumors of microscopic structure indistinguishable from sarcoma or carcinoma, after simple excision appear to be cured, in that the patients remain in good health for many years.

4. After excision of any type of parotid tumor recurrence may take place at any time up to 30 years.

5. This makes it difficult to be certain that any case is cured.

6. It also makes it certain that the tumors are malignant in themselves, and not by virtue of any sarcomatous or carcinomatous degeneration.

7. Except in the rarest cases there is no metastasis, so that the type of malignancy is peculiar.

8. The "mixed tumors" have a fairly regular rate of growth that is ordinarily very slow.

9. Occasional tumors of rapid growth are not necessarily more dangerous than others.

10. When growth is so rapid as to bring the patient to operation within a year and the excised tissue resembles carcinoma, the prognosis is bad.

11. The age at which the tumor appears has no bearing upon benignancy or malignancy.

12. It is not advisable to operate upon the tumors when small, as the smaller tumors are the more apt to recur.

13. Such data as are here offered suggest that except to improve the appearance and ease the patient's mind, it might be just as well not to operate upon these tumors.

14. It seems, as usual, that very little benefit to the patients has accrued from operations directed toward the removal of the rapidly malignant tumors.

15. Irradiation has not yet been shown to be of any benefit.

16. Whatever is to be decided upon, haste is probably never necessary and when operation is contemplated the accidents of facial palsy, salivary fistula and recurrence should be carefully considered for fear that more harm than good be done.

THE SURGICAL TREATMENT OF RECTAL TUBERCULOSIS

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IN 1924 the Department of Proctology of Glen Lake Sanatorium for Tuberculosis was created.

The average register of some 700 patients has offered an interesting field of observation during the past 8 years. The paucity of accurate records and laboratory data on rectal tuberculosis and the variation of opinion as to its frequency and method of treatment was startlingly apparent upon investigation of medical literature available at that time. I at once determined to outline a definite plan for systematically studying cases at Glen Lake. In 1926, Doctor Petter became associated with the staff in a full time capacity, and since that time has been my co-worker in this enterprise. His lasting enthusiasm and tireless energy has made this work possible. This present paper is the fifth presented on the subject since 1925 and it is interesting to observe that the conclusions recorded after 8 years of study, vary considerably from those recorded in 1925. It is likely there may be some change in our present ideas, but we do feel that these 8 years have enabled us to determine some facts which are of permanent value.

For the purpose of determining whether or not a lesion is tuberculous we use the three following methods: (1) the inoculation of a guinea pig with pus from the lesion, (2) the inoculation of a guinea pig with tissue from the lesion, and (3) the microscopic examination of tissue removed from the lesion.

In the first two we must always consider the possibility of contamination with the tubercle bacilli from more distant foci, hence, we consider the last named method the most valuable, and the only one not subject to the possibility of error. In 85 per cent of our cases the diagnosis was made from microscopic sections of tissue and in only 4 per cent were inoculation methods positive where tissue examinations were negative. The criterion acceptable on proving the lesion tuberculous is the presence, microscopically, of actual tubercle formation. More recently we have felt in certain very early cases that a microscopic picture termed tubercloid might possibly be included as conclusive evidence. In this case there is an infiltration of lymphocytes and epithelioid cells, which have not grouped themselves in true

tubercle formation, but are scattered throughout the section. The epithelioid cells are diamond or club shaped, and occur singly or in groups, and are often surrounded by lymphoid cells. Special stains occasionally show tubercle bacilli around epithelioid cells.

Surgery is indicated in rectal tuberculosis for two reasons: first to relieve the local condition which is often painful and second and often more important, to lessen the load of tuberculosis and infection which the patient is carrying. As an emergency measure such as drainage of an abscess surgery may be indicated almost regardless of the patient's general condition. As a rule, however, surgery should not be attempted unless the patient is in fair condition and there is reasonable certainty of the wound healing. The probability of the operative wound healing can be determined quite accurately in advance by the amount of fibrosis present in the lesion. Fibrosis is nature's method of healing tuberculosis, and if it is present to considerable degree in the rectal lesion, one may be quite sure that the patient is caring for his tuberculosis elsewhere, and that any operative wound will likewise heal promptly. This 'fibrosis index' is most valuable in determining the advisability of surgical interference and the prognosis in a given case.

The following outline shows the chief types of rectal tuberculosis and the advisability of operating, or not operating.

1. *Perianal cutaneous tuberculosis*: This group may be divided into 4 classes: (a) tuberculous anal ulcer—varying amount of fibrosis present, usually operable, (b) tuberculous cutis orificialis—terminal cases, fibrosis usually not present, not operable, (c) miliary tuberculosis of the anal skin—terminal cases, fibrosis usually not present, not operable, and (d) lupoid cutaneous tuberculosis—fibrosis present, always operable.

Perianal cutaneous tuberculosis is rare, there being only 18 cases in our series as compared with 152 cases of abscess and fistula. Of these 18 cases, 15 had tuberculous anal ulcers. In the primary stage, it cannot be definitely determined whether or not anal ulcers originate in the skin. In a typical case, the patient complains of definite pain, and perhaps some bleeding on defecation.

TABLE I.—RÉSUMÉ OF PERIRECTAL ABSCESS AND FISTULA IN ANO

| | |
|--|-----|
| Total cases | 52 |
| Records inadequate, thrown out | 19 |
| In residence | 20 |
| Awaiting surgery | 6 |
| Terminal cases | 23 |
| Patients operated upon | 104 |
| Percentage of males | 72 |
| Percentage of females | 28 |
| Age range, 18 to 7 years average 3 years | |

Examination reveals a simple anal fissure. If untreated, the patient may continue to complain and upon a second examination a week or two later there is found a ragged indurated, fiery red ulcer at the site of the previous simple fissure. Further examination usually reveals the sputum of the patient to be decidedly positive for tuberculae, indicating the presence of an active lesion. If untreated, these ulcers become in appearance more like the chronic type of ulcer. At this stage we may be uncertain as to whether the lesion originated in the skin or whether the original infection was in the rectal mucosa of a crypt of Morgagni. Instead of penetrating to the deep structures and forming an abscess and fistula, the infection extends superficially and involves only the anal skin in the ulcerative lesion. The lesion usually occurs in patients with slight or only moderate resistance to tuberculosis.

Tuberculosis cutis orificialis occurs in the mucous membrane and skin adjacent to the anus in patients having no resistance to tuberculosis. It appears as an ulcer progressively invasive in character destroying skin and sometimes mucosa, but not the deeper structures. No fibrosis is present and the condition occurs as a terminal complication. There were 3 cases in our series.

Miliary tuberculosis of the anal skin occurs in conjunction with highly virulent and rapidly fatal generalized miliary tuberculosis. This condition was not encountered in our series of cases.

Lupoid cutaneous tuberculosis occurs as a subcutaneous nodule covered by a bluish unbroken skin. As the condition progresses the skin becomes thin and shining and central necrosis and ulcer formation may occur. Lupoid tuberculosis occurs in patients with a well developed resistance to tuberculosis. There was 1 case in our series.

3. *Perirectal abscess and fistula* In this second group are found by far the most frequent tuberculous lesions about the rectum. Perirectal abscesses vary greatly depending upon the type of infection and the resistance of the patient. In one extreme we have a patient noticing the gradual formation of a painless, or nearly painless nodule,

TABLE IA.—SUMMARY OF 104 OPERATIVE CASES

| Other tuberculosis | Cases | Sputum positive | Laboratory pouch | Healed | Dead |
|-------------------------------|-------|-----------------|------------------|--------|------|
| Far advanced pulmonary | 80 | 77 | 78 | 7 | 8 |
| Moderately advanced pulmonary | 14 | 11 | | 14 | |
| Mucous pulmonary | 5 | | 4 | 5 | |
| None | | | | | |
| No clinical tuberculosis | 3 | | 3 | 3 | |
| Total | 104 | 98 | 93 | 95 | 8 |
| Percentage | | 87 | 89 | 91.3 | 7.7 |

| | Per cent |
|--|----------|
| Active tuberculosis present in | 95 |
| Active bone tuberculosis present | 8 |
| No demonstrable clinical tuberculosis present | 3 |
| Sputum positive | 87 |
| Proved tuberculous by (1) exudate in guinea pig or (2) tissue in guinea pig, or (3) tissue section or combination of (2 & 3) | 89.4 |
| Proved positive by tissue section alone | 85 |
| Laboratory work negative or none done | 1.6 |
| Healed | 91.3 |
| Patients died of other tuberculous lesions | 7.7 |
| Healed after re-operation | 5.0 |
| Patients discharged since 1906, total 1960 | |
| Percentage with abscess or fistula in ano | 3.0 |
| Patients discharged, 1906 to 1930, total 1807 | |
| Percentage with abscess or fistula | 5.8 |
| Patients now in residence with abscess or fistula | 6.0 |

near the anus. This nodule may continue to enlarge for 3 or 8 weeks. Finally it becomes somewhat reddened over a small area and a little later a small amount of thin flocculent seropurulent discharge is noted. Elevation in temperature, if present, is slight and is often not increased over that already present as a result of tuberculosis elsewhere in the body. This is a picture of a tuberculous abscess forming in a patient with good resistance to tuberculosis. In the other extreme, we have a patient who complains of severe pain, the rapid formation (24 to 48 hours) of an intensely red and tender mass near the anus. The temperature may be up to 103 or 104 degrees. If not incised, the abscess ruptures in a few days. This is the picture of a perirectal abscess occurring in a patient of low resistance, and it is not unlikely that the abscess is complicated by the presence of other organisms as well as the tubercle bacillus. All gradations between these two extremes occur. After the abscess has been drained and the acute symptoms have subsided, the fistula remains. The fistulas may be divided into four characteristic

clinical groups. Their appearance is dependent upon the patient's resistance and the virulence of the organism.

The first type presents a small external opening which may or may not be, surrounded by a nub of scar tissue. If a probe be passed into the fistula, the tract will be found to be small in diameter and well surrounded by scar. This type has no clinical appearance to differentiate it from a simple pyogenic fistula. It occurs in persons with marked resistance to tuberculosis or is due to an organism of low virulence.

The second type is characterized by a somewhat larger opening. Instead of scar, the margin of the skin about the opening appears to be thinned out and of a bluish red appearance. There may be a little seropurulent discharge. When the probe is passed into the opening a cavity of some size is found. This usually lies rather superficially underneath the skin and the probe can be moved freely from side to side. If the opening is large enough, so that the interior of the cavity may be seen, it will be found to be lined with pale flabby granulations. The amount of scar tissue present is much less. This patient has a fair amount of resistance to tuberculosis.

The third type shows a definite eaten out cavity with an internal opening as large as the rest of the tract. It would seem that the infection is advancing and destroying everything before it. No fibrosis or other tendency toward healing is present. This type of case is seen in persons with a rapidly progressive case of tuberculosis who have no resistance.

The fourth condition included under this head is the internal fistula or rectal ulcer. This condition occurs from a tuberculous infection in the rectal wall which produces an abscess between the mucosa and muscular wall of the rectum and does not appear externally. When seen after the abscess has broken down, there is found an opening in the rectal mucosa of varying size and a submucous cavity which also varies in extent. The variation of this picture usually corresponds in intensity with the first two types of fistulas just described.

3 Generalized tuberculous ulceration of the rectum corresponds with the third type of the fistulas just described. This condition is almost always associated with generalized tuberculous enteritis and is a rapidly progressing fatal condition.

When it is decided that surgery is indicated it is important that it be done thoroughly. Failure to cure rectal tuberculosis is more often due to timidity rather than boldness. In a few words

TABLE II — RÉSUMÉ OF PERI ANAL TUBERCULOSIS*

| Type | Cases | Treatment | Result |
|---|-------|---------------------------------|--------------------------------------|
| (3) Miliary tuberculosis | 0 | | |
| (4) Lepid tuberculous | 1 | Cautery excision | Healed |
| () T. tuberculosis cutis and (oficicula) | 2 | 1 general 1 cauterized twice | Died Died |
| (1) Tuberculous anal ulcer | 15 | 0 cauterized 3 no treatment | Healed Terminal cases— Died |

All patients had far advanced tuberculosis, all showed positive sputum.

it is necessary that all tuberculous tissue be destroyed and that all sinuses and overhanging edges of tissue be removed. A wide open wound, all parts of which are easily seen and which drains readily by gravity, should be left. After this it is usually only a question of careful dressing until the wound heals. The choice of anæsthetic is important. For obvious reasons general anæsthesia is usually not to be desired. We now do almost all of our work under spinal anæsthesia, 35 milligrams of procaine crystals being dissolved in 1 cubic centimeter of spinal fluid. This is ample for ordinary rectal operations.

Our actual operative methods have undergone some changes. In the beginning we used what was the generally accepted method, namely sharp dissection with a scalpel and scissors. In the cases with marked fibrosis, the results were very good. In the border line cases with little fibrosis, we found that frequently there was re-infection with tuberculosis, and even with secondary operations, numerous cauterizations, and caustic applications to secure healing, good results were not secured in all cases. We then began to remove the lesions with the actual cautery, or if some delicate dissection was required to use sharp dissection followed by cauterization of the wound with cherry red heat. Our results improved immediately but we felt that there was still room for improvement. The cautery is a rather clumsy instrument for doing some of the work in the rectum, and there is an eschar which is slow in separating after the operation. Also there is considerable postoperative pain. About a year ago we began using the endotherm knife and at present believe that it is an improvement over anything else used. It can be used in all cases, even for the most careful dissection and we feel that the time of postoperative healing has been definitely reduced. Like wise postoperative pain is slight, many patients requiring no opiates after operation.

Our method is simple consisting of removing all diseased tissue with the cutting current and then coagulating all parts of the wound with the coagulating current. Patients operated upon in this way show the same resistance to re-infection as those operated upon with the cautery but there is not the extensive eschar. This in turn is reflected in a shorter healing time.

Postoperative care is simple but extremely important and must be done carefully and faithfully. Hot sitz baths once or twice daily for all

but bed patients is routine. The wound is dressed once or twice daily. Mercurochrome or Iodoform gauze is gently packed into the wound to stimulate and keep it healthy. Granulations are kept down with silver nitrate stick. The medication may be varied as indicated but the most important consideration is that the wound be frequently dressed and kept stimulated with gauze. Under these methods our results have been most gratifying. The statistical charts give a definite idea of the results secured.

TREATMENT OF FRACTURES OF OUTER END OF CLAVICLE

AARON H. TRYNN, M.D., BROOKLYN

From the Service of Dr. S. Klemberg, Israel Zion Hospital, Brooklyn

IN a recent publication I called attention to the use of the Boehler clavicular splint in the treatment of dislocation of the acromioclavicular joint. It was pointed out that a condition for which open operation has always been resorted to in order to obtain a good functional, cosmetic, and

anatomical result can now be treated conservatively without discomfort to the patient. Fractures of the outer end of the clavicle with upward displacement of the inner fragment present the same problem. Although reposition of the fragments may not be difficult, the maintenance of reduction has never been accomplished satisfactorily. Open operation here too has been the usual method of treatment. In this paper I wish to present a case of this type of fracture and the results obtained with the use of this splint.

The apparatus, as pointed out (Fig. 1) consists of a board, *a*, 30 centimeters long, 15 centimeters wide and 5 centimeters thick. The part fitting into the axilla is smoothed into a Gothic arch to fit the concavity of the axilla. Two malleable iron ribbons, *b* and *c*, 50 by 4.4 centimeters, with two short belts made of webbing are fastened to the main part of the splint and are used to fasten the splint to the trunk. A third webbing, *d*, attached to the bottom of the splint is fastened over the normal shoulder and is used to raise the injured shoulder. A fourth belt *e* with a buckle is introduced under the lower iron ribbon and is used to press the inner fragment of the clavicle down. All parts are well padded and under the webbing used to exert pressure on the clavicle a felt pad is placed.

The purpose of the treatment is to counteract the reflex contraction of the trapezius which draws the inner fragment of the clavicle upward and to overcome the weight of the arm which draws the outer fragment down. These forces act similarly in acromioclavicular dislocation. Desault and Velpaux bandages have been used but after removal the deformity has been found to have re-

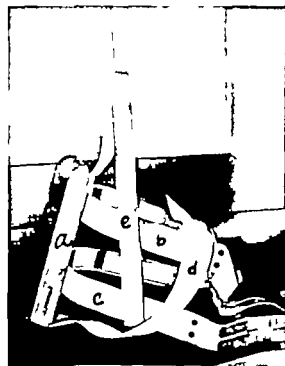


Fig. 1. The Boehler clavicular splint.



Fig. 2. Fracture of the outer end of the clavicle with separation of the fragments.



Fig. 3. Reduction obtained after application of the splint.

curred. Shaar has described an elastic traction splint for acromioclavicular separation. Traction on the clavicle downward is supplied by rubber tubing and a canvas strip which is attached to a canvas strip support to the arm. This is similar to the method advocated by Currie consisting of two buckled webbing straps over the acromioclavicular joint and around the flexed forearm. No provision is made for elevating the acromion or acromial end of the clavicle while the inner fragment is pulled downward. The extremity is immobilized to the side throughout the period of treatment and in older individuals causes a stiffness of the shoulder and elbow joints. The downward pull on the clavicle in both methods depends on the weight of the arm and once the arm is raised or the forearm is flexed, this downward pull is lost and the fragments are displaced.

In treating this type of injury, three important requirements must be satisfied. Constant downward traction must be maintained on the inner fragment, constant upward pressure must be exerted on the outer fragment and there should be freedom of motion of the shoulder and elbow joints. The advantage to the patient is quite evident. Prolonged immobilization causes atrophy of the muscles which often taxes the patience of the surgeon to overcome. The clavicular splint described satisfies all these requirements.

CASE REPORT

M. N., age 16 years, sustained a fracture of the right clavicle on May 16, 1932. A visible prominence was present at the region of the acromioclavicular joint. Roentgenogram (Fig. 2) showed a fracture of the outer end of the clavicle with upward displacement of the inner fragment. Simple pressure on the clavicle reduced the fracture



Fig. 4. Eight weeks after the fracture 2 weeks after removal of splint.

but this reduction could not be maintained with the ordinary retaining bandages. The clavicular splint was applied. Roentgenogram after 24 hours (Fig. 3) showed the fracture reduced. The apparatus was maintained for 6 weeks. A final roentgenogram taken 8 weeks after the injury—2 weeks after removal of splint—showed the fragments in good alignment and early callus formation.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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JULY 1933

SIR ROBERT JONES

ON January 14, 1933 surgery sustained a great loss in the death of Sir Robert Jones. Certainly no British surgeon ever had greater influence on American orthopedic surgery than he.

Robert Jones was born in 1858 in Wales, took the diploma of the Royal College of Surgeons at the early age of twenty, became associated with his uncle, Hugh Owen Thomas, the son of a famous bone setter, a man of rare ability and the originator of the Thomas splint, and soon was appointed to the surgical staff of the Royal Southern Hospital of Liverpool. Hugh Owen Thomas' private and charity practice was very large and chiefly industrial. It was therefore not strange that, although Sir Robert's efforts were at first along general surgical lines, his practice ultimately became so predominantly orthopedic that he found it necessary to limit it to that specialty. Thus was established the most interesting orthopedic clinic in Europe.

Although the work of Jones was well known early by the small group of surgeons comprising the American Orthopedic Association, it

was not until 1907 that American surgeons as a whole appreciated the remarkable work he was doing. The interest of these men was awakened by William J. Mayo who in 1907 following one of his many journeys abroad forcibly called attention to what was going on in Liverpool. He said: "Just as Lawson Tait carried sound surgery into the abdomen and Mr. Victor Horsley into the cranial cavity, so has Mr. Jones carried sound surgical principles into orthopedic practice, and rapid cures are the result in a large number of cases in which treatment had been given for months and years by orthopedic apparatus. This does not mean that Mr. Jones has discarded these measures. He is most careful in the after-treatment and uses mechanical contrivances for their proper purposes as an adjunct to surgery, not in place of it. All operations are done under ether anesthesia. The asepsis is most painstaking and thorough. He is expeditious, yet neglects not the smallest detail and his wonderful experience enables him to do wizard-like operations with a precision that is startling. So unassuming and modest is the man that he is I believe entirely unaware of his great ability. Sir Robert's operations were models of technical skill and his plans of treatment examples of an orderly attack on the problem to be solved. One soon discovered that his real enthusiasm was for the ultimate result to be achieved and not for the brilliance of the actual operation. The ease with which he would perform fifteen to thirty operations in an afternoon was astonishing."

As the years went by many honors came to him. He was knighted in 1917, two years later was appointed Knight of the British



Nobel Jan,

Empire, was elected to fellowship in the English and Irish College of Surgeons and also received the American Distinguished Service Order. He received the F. R. C. S. (Edinburgh) in 1889. The Universities of Wales, Aberdeen, Liverpool, Harvard, and Yale gave him honorary doctorates and the American College of Surgeons elected him an honorary fellow.

When the war broke out in 1914 and the British hospitals were soon filled to overflowing with the injured sent home from France, many of the surgeons of the country were in service abroad and the organization for the care of this large number was totally inadequate. The government called on Sir Robert to take charge, and he immediately rose to meet the situation. He segregated the cases and developed the personnel for their care. The first center established was Shepherd's Bush, London, and in this effort he called on his American colleagues to come to his aid. He was able gradually to establish many other military orthopedic hospitals until there were finally 33,000 beds given over to orthopedic service in England. Following the war, Sir Robert exerted his energies for the prevention and cure of crippling diseases and was first chairman and later president of the Central Council for the Care of the Cripple.

On his seventieth birthday a volume of collected essays was presented to him as an assurance of the high esteem in which he was held by his colleagues and former pupils.

As a teacher he was pre-eminent, not in the rôle of the didactic pedagogue, but in the rôle of a leader able to enthuse men, and through them he advanced the art and science of his specialty. During his busy years Robert Jones was thinking, and by speech, writing, and clinical teaching, he inspired many. His contributions to orthopedic surgery were numerous and his *Text Book of Orthopedic Surgery*,

written in conjunction with his old friend the late Robert Lovett, is much used in America.

Sir Robert's success cannot be explained by mere achievements in the realm of surgery. His personality was remarkable, the spark of real genius existed in a man of great physical endurance, with a well balanced outlook on life. These attributes brought him fame and renown, and one only had to know him to realize that they also brought him happiness.

In the preface to the birthday volume mentioned, Lord Moynihan wrote in his inimitable style: "Few men have ever possessed in so radiant a degree the genius for friendship. No one can be long in his company; none can work with him or play with him, without realizing not only the sweet simplicity of his character but the greatness of his heart. In a long and very intimate friendship I have never heard an unjust criticism, a cruel gibe or a word of bitter cynicism on his lips. His personality radiates cheerfulness, good temper and good will."

In 1911, following in the footsteps of many others, it was my good fortune to visit Sir Robert. I landed at Liverpool on Saturday, and decided to attend his usual Sunday morning free clinic. On setting out from the old Adelphi Hotel, I inquired how to reach 11 Nelson Street, and was given the general direction and told that I could not miss it for I would see the lame and the halt with their crutches and canes making their way to the great physician. Thus guided I easily found my way and on entering the building and making myself known I was taken immediately to Sir Robert and introduced to him. I have never forgotten the cordial friendly welcome accorded me and the ease with which I was fitted into the routine of a busy clinic in a few days. I was given a white coat to wear and was introduced to Sir Robert's patients as his American assistant. That first Sunday

morning I was astounded at the large number of patients he saw, all charity and the large percentage that he actually did something for on the spot. Malunited fractures not yet solidified, were straightened, club feet were manipulated, bow legs of babies fractured straightened and splinted and stiff shoulders with periarticular adhesions manipulated. All this was done without anesthesia and so quickly was it done under the spell of the man's personality that it seemed incredible.

The several months that I spent in daily contact with Sir Robert Jones are among the most enjoyable of my professional career. Another young American, Dr. Henry Fitzsimmons, a pupil of Robert Lovett of Boston was there at the same time and we enjoyed together the rare privilege of association with this master. We were taken with him on his visits to Herwall on the banks of the river Dee where the new Children's Hospital was situated and to Baschurch where there was at that time a primitive sort of a hospital with open air shelters. This hospital was presided over by a remarkable woman of unusual force and character, Dame Agnes Hunt, a former patient of Sir Robert. The Baschurch Hospital later became the prototype of the Cripple's Hospitals in England. In the private clinic at 11 Nelson Street where we were in daily attendance Sir Robert was never too busy to take the time to show us the interesting cases, explaining the problems presented in each case, and always emphasizing the

point in the case that was important. He radiated energy, friendliness, and kindness, and his patients came immediately under the spell of his personality. If the so-called art of medicine was ever personified in its highest form in one individual it was in Sir Robert Jones. With all the very apparent high idealism that prevailed in his clinic one might expect aloofness and dignity but on the contrary there was softening humor and humaneness that was delightful. Never did we hear criticism of a colleague or of previous treatment. The correct diagnosis and treatment would be outlined, but nothing derogatory of previous efforts was ever mentioned no matter how richly to our younger minds it seemed deserved.

In 1918 he suffered a great and almost crushing loss in the death of his wife. Their family life was ideal. Lady Jones was his companion in his life work, and many recall the delightful hospitality that was extended to those fortunate enough to visit in their home. Sir Robert lived to the age of seventy-four in full health and surprising vigor up to within a few months of his death. He is survived by a son, a member of the bar who succeeds to the title, and by a daughter. The news of his death came as a shock to his many American friends, for he seemed to have perpetual youth and one simply could not think of him as growing old. His death came as we all would have wished it for him, quietly and quickly.

M. S. HARRISON

HOW SHALL WE TREAT BRAIN ABSCESESSES?

NOT many years ago there would have been but one answer to that question—evacuation and drainage. There was little variation in the technique, the operation was performed once an abscess was suspected and localized, and the mortality was distressingly high. Since the Great War, and more particularly during the past ten years, the subject has been given more intensive study. More attention has been paid to the histopathology of brain abscess, more techniques have been proposed, and there prevails today a much clearer understanding of the problems involved—diagnosis, localization, treatment. Of these three we will consider only the treatment. Under treatment there are two major questions when to operate and how to drain. There is no doubt that many of the failures of the past should be charged to ill timed operations, operations undertaken before the abscess was thoroughly encompassed by a well organized capsule. *We must acknowledge that an abscess in the making is not a surgical lesion.* To be master of the situation, the surgeon's mind must be continually focused on the process of encapsulation. It is reasonably safe to assume that fibrous encapsulation, that is the transformation from the migrating lymphocytes into fibroblasts and mature connective tissue, requires at least three weeks. The process of encapsulation is by no means uniform as to time. In some cases, for reasons unknown, the development of the connective tissue elements proceeds more slowly than in others. *The question constantly before the operator is not "how soon can I operate," but rather "how long is it safe to defer operation."* It is here that the operator's judgment is

taxed to the utmost, and, since so often the actual date of the primary infection is undetermined, the operator must be guided chiefly by the signs of increased intracranial pressure, particularly headache and papilloedema.

According to Lillie¹ attempts at drainage should be deferred until the choking has attained its maximum and the discs have become quiescent. Quite recently Woltman,² as a guide to the degree of encapsulation advocates a study of the cellular elements of the cerebrospinal fluid. There is no ground he says, for the traditional fear of lumbar puncture in the presence of a brain abscess. If the neutrophils are present he assumes that encapsulation is not progressing satisfactorily. When, however the lymphocytes in the cerebrospinal fluid predominate, he assumes the conditions for operation are more favorable. If these observations of Woltman are generally accepted we will have the only specific guide as to when the operation should be performed. At all events *an operation, premature usually spells disaster. Procrastination may lead to disaster by rupture of the abscess into the ventricles or by a foraminal hernia.*

During the past ten years three radically different procedures have been practiced (1) the conventional tubular drainage, (2) drainage by the King method³ in which unroofing and herniation are the principal features, (3) repeated evacuation as practiced by Dandy.⁴ The King method has claims to originality, but statistics are not available to permit of its evaluation. Repeated evacuation by the Dandy method should be given preference, at least when the pus contains no organisms and in small deep seated abscesses. Coleman⁵

¹Acta oto-laryngol., 1917, 17, 479.

²J. Am. M. Ass., 1926, 8, 10.

³Surg., Gynec. & Obst., 1914, XXXIV, 554.

⁴J. Am. M. Ass., 1925, October 30.

⁵J. Am. M. Ass., 1926, 207, 558.

recommends a subtemporal decompression synchronous with tapping to prevent the ill effects of a secondary rise of intracranial pressure.

We have been impressed with the writings of Coleman (loc. cit.) and with the results which he obtained in his series of 28 cases. Coleman prefers drainage with a soft rubber catheter as inflicting the minimum degree of trauma. The catheter is allowed to remain *in situ* until extrusion takes place. For the present, one or the other of these two methods that of Coleman or Dandy must be accepted as the method of choice.

We must not forget as reminded by the title of an article by Globus and Horn 'Inherent Healing Properties of Abscess of the Brain' that there are certain instances in which these inherent healing properties may continue until resolution is complete. Again

there are certain cases in which the abscess wall is so firm that the operator has removed the lesion *in toto* in the belief that he was dealing with a neoplasm. With this in mind the question at once arises, will the time come when this method will become the accepted procedure. The final pronouncement cannot be made until there have been assembled reasonably large series of cases treated by one or the other of these methods. But the reader will have gathered from the tenor of these remarks that the tendency of the day is away from the early operation and toward procrastination until encapsulation is secure. It may be as time goes on by repeated tapping or complete excision fewer lives will be lost from rupture of the abscess or from the effects of increased pressure—the consequence of delay—than now are lost by attempts at drainage earlier in the course of the disease.

CHARLES H. FRAZER.

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

IN a foreword we are told. These *Archives of Obstetrics and Gynecology*¹ are to be made up of contributions by the outstanding men of America chiefly heads of departments and prominent teachers in our leading medical schools, and this work will be the first chapter in the continued history of what America has to tell about obstetrics and the diseases of women. It is planned to publish a new edition every five or eight years, and a new editor is to be chosen from time to time, in order that this work may secure a continuous and permanent place in our literature.

In such a way the general scheme of this large undertaking is outlined before us. As its syllabus indicates, the contributions are in reality a series of monographs, written by their respective authors and yet at the same time influenced, modified and integrated into a system under the supreme authority of the editor himself.

Accordingly there is implied here not only the individual labor but also a co-operation and a team work as between the contributors themselves, the result of many conferences and unselfish good will. This quotation indicates the special kind of editor who has inspired and controlled this publication.

The work is to appear in three volumes, each of some eleven hundred pages. Dr. Franklin H. Martin in an introductory chapter entitled "The New Surgical Literature," speaks of it as "An encyclopedia of obstetrics and gynecology" and prophesies that "it will become an inspiration to the specialist, a guide to the independent practitioner, a model for teachers, and a comprehensive textbook for advanced students. Certainly no publication of such magnitude, dealing with these two subjects has been undertaken since the appearance, in 1924, of *Biologie und Pathologie des Weibes* in eight volumes, by Professors Halban and Seitz. It is true that in England *The Practitioner's Encyclopedia of Midwifery and the Diseases of Women*, edited by John S. Fairbairn, was published in 1921 while later in 1924 there was added a textbook, *Gynecology with Obstetrics* written by Dr. Fairbairn himself. In Scotland in 1923 *A Combined Text-book of Obstetrics and Gynecology* was issued by Professor Munro-Kerr and Drs. J. Haig Ferguson, J. Young and J. Hendry. These British publications, however, are comparatively small and were written specially for the undergraduate student.

No one has pleased more eloquently than Dr. Fair

baire for the natural and organic union that should exist between these two subjects of obstetrics and gynecology and no one will welcome more cordially than he this union, as exemplified in these present *Archives*. In the introduction to his own *Encyclopedia* he pronounces the two subjects as one and indivisible and quotes the words of John Calvin "It is a dull and obtuse mind which divides in order to distinguish, but it is a still worse which distinguishes in order to divide."

There certainly is nothing of division in our welcome to this American *Encyclopedia*.

The first volume has just appeared, and it is of this that we now speak.

Naturally this first volume deals with the anatomy of the female genital tract and with the physiology of these reproductive organs. Special sections are devoted to the morphology and the physiology of pregnancy, to the physiology of the birth processes to labor, and a final section to the pathology of pregnancy.

The Anatomy of the Female Genitalia and Pelvic Soft Parts has been written by Barry J. Anson, associate professor of anatomy, Northwestern University, Chicago. While the descriptive text is clear and succinct it is greatly strengthened by the original drawings, which have been made by W. Branks Stewart, under the author's supervision. These drawings show originality both in conception and execution, and it is evident that they have been prepared with great care. An editor's note informs us that every effort has been employed to correct the inevitable distortion of postmortem dissections, by a painstaking comparison of measurements taken in the living subject during pelvic operations.

Fred L. Adair, professor of obstetrics and gynecology, University of Chicago has long been recognized as an authority upon the bony pelvis. In this chapter, "The Bony and Ligamentous Pelvis," he naturally deals first and chiefly with this subject from the obstetrical point of view. Fortunately, however, he has added to this description many interesting details concerning the ontogeny and phylogeny of this weight-bearing girdle. The pages that deal with the ossification and development of this bony pelvis are worthy of special mention.

Emil Novak, of Johns Hopkins University writes of the "Physiology of the Reproductive Organs (exclusive of Pregnancy)" and no one could do it better. This physiology is really embraced and included in the function of menstruation. Its me-

¹OBSTETRICS AND GYNECOLOGY. Edited by Arthur Hale Curtis, M.D. Vol. I. Philadelphia and London: W. B. Saunders Company, 1933.

narche, its menarche, and its menopause. The cyclical changes in the genital canal associated with menstruation are clearly described, the illustrations are well chosen, and have been clearly reproduced. Novak is here writing on his own special subject.

There follows a chapter on 'Menstruation in the Light of the Newer Knowledge concerning the Physiology of Reproduction,' written by Novak, and Carl G. Hartman, of the Carnegie Laboratory of Embryology Johns Hopkins University. We specially commend this chapter dealing as it does with the modern endocrine viewpoint of the physiology of menstruation, and also a most interesting description of "The Reproductive Cycle in Animals," written by Hartman himself. We gladly endorse the tribute paid to Marshall's hand book *The Physiology of Reproduction*, its second edition, published ten years ago as "a mine of references and a most useful initial guide to wider reading."

The chapters on "Morphology and Physiology of Pregnancy" are among the strongest in the book, in especial those dealing with Maturation and Fertilization of the Ovum, "The Early Development of the Embryo" and the chapter on Placentation, Fetal Membranes, and Decidua. Professor Bradley Patten, of Western Reserve University Cleveland, and Carl G. Hartman, of Baltimore, "have sorely made," in the words of the editor, "a great team." The photomicrographs of the fertilized and living ovum of the monkey showing its cleavage divisions, and its growth changes, are the best that we have seen. In micro-moving pictures, these cleavage divisions begin with the two cell stage, and are carried on to the eight cell stage, 49 hours and 45 minutes after ovulation. In this way the morula stage is reached. The blastula changes are shown, from living embryos of the rabbit, with the formation of the blastocoele and the inner cell mass, which carries us by a single hypothetical stage to the condition of the human embryo, 10 to 11 days after fertilization, in the famous Miller embryo as described by Streeter. In this way and by these stages, the initial chapter of the life history of the human embryo has been wonderfully depicted.

"Placentation, Fetal Membranes, and Decidua" are described by Professor Leale Brainerd Arrey, Northwestern University Medical School. He describes the early penetration of the uterine mucosa by the guinea pig ovum, and passes directly to a description of the embedded human embryo of Miller Bryce Teacher and Peters. Of the fetal membranes it is interesting to observe that the amniotic cavity is already formed in the Miller embryo, probably by a splitting of the ectodermal cell mass. Farther than this assumption, even yet, we are not permitted to go. It is a pleasure to read these pages of Professor Arrey for the scientific description is not only well illustrated, but is charged with items of clinical value and importance.

There follow interesting chapters on "Diseases

of the Embryo and Appendages," by Professor A. Schumann, and one on "Maternal Changes Incident to Pregnancy" by J. Alfred Hofbauer of Johns Hopkins University but space forbids any thing more than a mention of these.

"The Diagnosis of Pregnancy and its Management" are well up to the level of our standardized textbooks, and admittedly this standard is high. The same may be said of the section of "Labor." In the "Conduct of Normal Labor" Professor Joseph Baer of Rush Medical College, University of Chicago speaks of delivery in the left lateral position as a method which has not received sufficient recognition in America. We think this statement is true. To the several advantages of this position, enumerated in the text, we would add one other namely its great usefulness in a private house where hospital facilities, and assistants are few or wanting altogether.

Professor Patten makes a definite contribution to our knowledge of "Changes in the Fetal Circulation Following Birth." He adds the key-stone to the arch of our understanding of the gradual closure of the foramen ovale, the antenatal and neonatal pulmonary circulation and the active histological changes at work in the closure of the Ductus arteriosus.

Our interest in "The Pathology of Pregnancy" naturally centers around the toxemias. This chapter has been contributed by Robert D. Munsey and Lawrence M. Randall, of the Mayo Clinic. These authors have successfully resisted the modern temptation of loading their pages with too much of theory, and have confined themselves happily to clinical distinctions. Their sharp separation of chronic nephritis from the true toxemias will meet with approval and also their general recommendations concerning antenatal care, early diagnosis, and treatment.

No review of this first volume would be complete without a special reference to the early chapter "Historical," written by Irving S. Cutter, dean, Northwestern University Medical School. This monograph is a well balanced summary of the history of obstetrics and gynecology in Great Britain, France, Germany and America. Clearly conceived and written, it provides the reader with an excellent introduction to the work before him.

The volume itself has been well produced, both in its text and illustrations.

We congratulate Dr. Curtis, his contributors, and his editorial staff.

W. W. CHAFFIN.

AN unusual book in some respects an extraordinary book, an extraordinarily good book is *Peripheral Vessels Injuries* by Pollock and Davis. The assembled material is nowhere else duplicated and I am inclined to doubt that there are anywhere two other men who could duplicate it.

BECKER'S SURGICAL MONOGRAPHS. PERIPHERAL NERVE INJURIES. By Lewis J. Pollock, M.D. and Loyal Davis, M.D. New York: Paul B. Hoeber, 1933.

That every neurological surgeon and every neurologist will soon possess this monograph (678 pages) is obvious. Assuredly every industrial surgeon should have it. If and when we have another war it will become a *vade mecum*. In fact any physician who has to do with peripheral nerve injuries will find himself in need of this comprehensive manual. The following will convey an idea of the contents.

After a brief chapter on the incidence of peripheral nerve injuries, nine fertile chapters (97 pages) are devoted to "Examination." They include a lot of symptomatology especially relating to overlap and sensory dissociation. That is, one is told what to look for how to look for it, what one finds and how to interpret the findings.

Follow three valuable chapters (27 pages) on "Diagnosis" wherein the chaff is blown from the wheat theory rendered negative by the facts of experience. Chapter XIV is peculiarly lucid and contains all that any clinician needs to know of the development and structure of peripheral nerves. In Chapters XV and XVI the authors very adequately cover the pathology of peripheral nerve lesions and the fascinating processes of nerve degeneration and regeneration—almost a *terra incognita* to the ordinary run of physicians and surgeons.

In Chapter XVII will be found explicitly set forth the indications—and contra indications—for surgical treatment. dicta rational as well as explicit and in the following one brief descriptions of nerve transplants or grafts nerve implants nerve crossing nerve flaps suture a distance, tubular suture and end-to-end suture.

The technique of the various surgical procedures for nerve repair is very clearly described in 24 pages (Chapter XIX) and statement of what should be and can be done in the way of after treatment follows. As quite germane to the subject in hand tendon transplantation, neurotization of paralyzed muscles and immobilization of joints are summarily considered in Chapter XXI.

Pages 264 to 544 are devoted to the symptomatology, diagnosis, and treatment of injuries of the various individual nerves, including the brachial and other plexuses and multiple lesions and what these pages contain is bound to become classic medical literature. For instance, the 34 pages on the radial nerve and its injuries constitute a veritable mine of authentic information and sound counsel. They leave nothing essential to be said. The same applies to the text on the other nerves. The matter is based on extensive experience accurate observation full knowledge of the work of others and sound judgment. It is especially to be noted that the choice of operative procedure receives mature consideration and that operative technique is presented in detail.

Finally there is a very instructive chapter on the results of peripheral nerve surgery. It contains a vast amount of information but lacks the personal opinion—or impression—of the authors.

The text is followed by a colossal bibliography

(1958 titles), a monument to someone's untiring industry and meticulous care. Then a full index of authors with page references and a subject index which should put European authors and publishers to shame.

The illustrations are unexcelled, mostly original, some of them beautiful, and they really illustrate.

In the presence of so many major excellencies it is painful to note a considerable number of minor blemishes—easily to be removed in a second edition. Frequently the English is loose, sometimes even inaccurate or vague. Weir Mitchell's first name is misspelled at least seven times, three times on one page. On page 257 the text does not agree with the legends of the illustrations. There is some needless duplication of statement and some scores of articles (a and an) might well be deleted.

HUGH T. PATRICK.

WRITTEN primarily for roentgenologists and based on 309 verified tumors *Intracranial Tumors* is quite complete. The types of Intracranial tumors are well classified and some are dealt with in detail. The second chapter dealing with direct roentgenological evidence of intracranial tumors, is well written and covers the field very satisfactorily especially the pineal gland calcification and the importance of a shift in its position.

Chapter three dealing with meningiomas, classifies these tumors regionally describes them roentgenologically, pathologically and enumerates symptoms. The origin of meningiomas is brought out very clearly. The case reports throughout the book are very concise and clear also the operative and postmortem findings are given in a quite complete manner. Davis divides meningiomas into two groups (1) massive roughly spherical, and (2) flat slightly elevated.

Hypophyseal adenomata are covered in chapter four. The tumors are classified according to their staining characteristic, namely chromophobe chromophil, and basophilic. The chromophobe are the commonest the chromophil the next in order and the basophilic adenomata are comparatively rare. The symptoms and clinical findings are usually diagnostic of the types of adenomata, namely, chromophobes with hypopituitarism and chromophil with hyperpituitarism. The X ray findings are often of great value in the diagnosis of hypophyseal adenomata. The ballooned-out type of erosion is quite characteristic of intrasellar tumors. The findings must be closely studied as other types of extrasellar tumors often cause changes in the sella and clinoid processes. Other X ray findings are also described such as large supra-orbital ridges, thick skull large external occipital protuberance and the prominent jaw.

Acoustic neuromata and cranio-pharyngiomas are covered in chapters five and six. The X ray

findings in acoustic neuromas are in and about the porous acusticus. Usually the changes are of a destructive character. Positions best to show these areas roentgenologically are described. The cranio-pharyngiomas are tumors of childhood or early adult life. They are congenital and are usually located in the hypophyseal region—"Rathke's pouch." These tumors are very frequently calcified and therefore give direct X-ray findings. The areas of calcification are usually located above and anterior to the sella, although occasionally deposits may be found in the sella. Both types of tumors, acoustic neuromas and cranio-pharyngiomas are covered very completely in the book.

In chapter seven the gliomata, osteomata, and angiomata are described giving case reports and a few X-ray illustrations. The gliomata give very little direct X-ray evidence, due to the fact they are not often calcified nor do they show calcified deposits. The osteomata and angiomata are not described in detail, but the important points are well brought out.

The chapter on ventriculography and encephalography is very complete reviewing the literature and describing the various methods used in both ventriculography and encephalography. The ventricular pathways are completely described and the causes of changes in the pathways are enumerated. The

author gives a sign of warning which is important namely try to make a diagnosis by the older methods before subjecting the patient to either ventriculography or encephalography. Each method is a surgical procedure and should be reserved for a patient with an unlocalized lesion and then only in a hospital under the best surgical conditions.

The last chapter on radiation therapy of intracranial tumors reviews the literature and gives the views of many radiologists and neurologic surgeons, plus the technique used by the author. The effects of radium and X-rays on brain tissue is discussed with warnings not to use large doses (above 1000 r) at one session. Headaches, edema and hyperemia often follow large doses of irradiation.

The book, I believe, fills a much needed space in a rather new but rapidly growing field of surgery. The book is well written, in rather large type and is interesting to read.

Our only criticism is that the X-ray reproductions are not clear and many of the areas mentioned in the text and legends are very difficult, and in some instances impossible to find. It is our belief that too many conclusions are drawn from the X-ray reproductions. It is possible that the conclusions drawn from the X-ray findings were very evident on the original films but could not be plainly reproduced on prints.

EDWARD L. JERKINSON

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

INTRACRANIAL TUMORS. By Percival Bailey. Springfield, Illinois and Baltimore: Charles C. Thomas, 1933.

A SURGEON'S POCKET BOOK. By H. S. Souttar, D.M., M.Ch.(Oxon). London: William Heinemann Ltd., 1933.

ZANGEMEISTER IN ROENTGENFELD. By Dr. Walter Laetge. Munich: Ernst Reinhardt, 1933.

LUENT THERAPY. By Frank Hammond Krusen, M.D. New York: Paul B. Hoeber Inc., 1933.

ANNALS OF ROENTGENOLOGY. Edited by James T. Case, M.D. Vol. PRATIC DICTIO. By Jacob Buckstein, M.D. 2d rev. ed. New York: Paul B. Hoeber Inc., 1933.

OPERATIVE SURGERY THE OPERATIVE TECHNIC INVOLVED IN THE OPERATIONS OF GENERAL AND SPECIAL SURGERY. By Warren Stone Bickham, M.D. and Calvin Marsh Smyth, Jr. B.S. M.D. Vol. vii. Philadelphia and London: W. B. Saunders Company, 1933.

ABORTION LEGAL OR ILLEGAL? By A. J. Rooy, M.D., F.A.C.S. New York: The Vanguard Press, 1933.

SURGICAL OPERATIONS FOR STUDENTS AND NURSES. By L. W. Hey Groves, M.D., B.Sc., M.S., F.R.C.S. 3d ed. New York and London: Oxford University Press, 1933.

BIPOLAR VISION AND THE MODERN TREATMENT OF SCOTOMA. By Margaret Dolson, M.D. (Lond.) London: Oxford University Press, 1933.

THE PRINCIPLES OF TREATMENT OF MUSCLES AND JOINTS BY GRADUATED MUSCULAR CONTRACTIONS. By Morton Smart, C.V.O. D.S.O., M.D., Ch.B. (Edinb.) London: Oxford University Press, 1933.

OPERATIVE SURGERY. By Alexander Miles, M.D. LL.D. F.R.C.S. Ed. and D. P. D. Wille, M.D. F.R.C.S. Ed. and Eng. London: Oxford University Press, 1933.

THE NERVOUS CHILD AT SCHOOL. By Hector Charles Cameron, M.A., M.D. (Camb.) F.R.C.P. (Lond.) London: Oxford University Press, 1933.

IDENTIFIED ABNORMALITIES OF THE SKIN, AND ITS AFFECTIONS. By E. A. Cockayne, D.M., F.R.C.P. London: Oxford University Press, 1933.

FORTSCHRITTE AUF DER GEBIETE DER ROENTGENSTRALUNG. Edited by Prof. Dr. Gumbay. Vol. xlv. DIE KONSTRUKTIVE ENZEPHAL-ARTHOGRAPHIE. By Prof. Dr. W. Leehr. Prof. Dr. W. Jacob. Leipzig: Georg Thieme, 1933.

LES VOIES DE PÉNÉTRATION DES MÉDICAMENTS. Tome II. MÉDICAMENTS INJECTÉS. By F. M. Cadenat. Paris: G. Doin & Co, 1933.

ESSENTIAL HANDBOOK ON RADIUM etc. By D. F. Clephen, H. M. Hill. London: Oxford University Press, 1933.

ROENTGENOGRAPHIC STUDIES OF THE URINARY SYSTEM. By W. E. Lower, M.D., F.A.C.S., and B. H. Nichols, M.D. F.A.C.R. St. Louis: The C. V. Mosby Company, 1933.

THE PRACTITIONER'S LIBRARY OF MEDICINE AND SURGERY. Vol. IV. NONTRAUMATIC SURGERY. New York and London: D. Appleton and Company, 1933.

VORLESUNGEN ÜBER BEKANNTE UND UNBEKANNTE OPERATIONS-GEFÄHREN. By Prof. Dr. M. Kappas. Leipzig: Georg Thieme, 1933.

A NEW APPROACH TO DIETETIC THERAPY; METABOLISM OF WATER AND MINERALS AND ITS DISTURBANCES. By Eugene Fockes, M.D. Boston: Richard G. Badger, 1933.

THE PHYSIOLOGICAL EFFECTS OF RADIANT ENERGY. By H. Laurens. Ph.D. American Chemical Society Monograph. New York: Chemical Catalog Company Inc. 1933.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

J. BENTLEY SQUIER New York, *President*

WILLIAM D. HAGGARD Nashville *President Elect*

FRANKLIN H. MARTIN Chicago *Director-General*

PHILIP H. KREUSCHER *Chairman* OSCAR E. NADEAU *Secretary Committee on Arrangements*

PRELIMINARY PROGRAM FOR THE CLINICAL CONGRESS IN CHICAGO

IN the following pages appears a preliminary program of operative clinics and demonstrations to be given in the hospitals and medical schools of Chicago during the twenty third annual Clinical Congress of the American College of Surgeons, October 9-13, 1933. It will be noted that clinics are scheduled to begin at 2 o'clock on the afternoon of Monday, October 9, and to continue during the four following days both morning and afternoon. All departments of surgery will be represented in the clinical program—general surgery, gynecology, obstetrics, urology, orthopedics, proctology, and surgery of the eye, ear, nose and throat.

The clinical program is being prepared under the supervision of the Committee on Arrangements appointed by the Board of Regents which Committee is comprised of the members of an Executive Committee—Philip H. Kreuscher, chairman, Oscar E. Nadeau, secretary, Joseph Beck, William R. Cubbins, Frederick H. Falls, Harry S. Gradle, Carl A. Hedblom, Charles E. Kahlke, Herman L. Kretschmer, Karl A. Meyer, Dallas B. Phemister, Edwin W. Ryerson, and Henry Schmitz—together with representatives of each of the hospitals and medical schools co-operating in the clinical program.

The surgeons of Chicago are keenly interested to present a program of clinics and demonstrations that will provide a complete showing of this city's clinical activities in all departments of surgery. The Committee on Arrangements in making their plans has been assured of the hearty co-operation of the clinicians in the medical schools and more than fifty hospitals that will participate in the clinical program. The Committee is planning for a number of special features in the clinical program to include (1) Demonstrations at several hospitals of modern methods in the treatment of fractures, (2) cancer clinics demonstrating the treatment of cancer by surgery,

radium and X-ray (3) clinics in traumatic surgery demonstrating the newer methods of rehabilitation by surgery and physiotherapy of patients injured in industrial, automobile and other accidents.

Two sub-committees have been appointed to supervise the program for the sections on surgery of the eye, ear, nose and throat as follows: Ophthalmology—Harry S. Gradle, chairman; Thomas D. Allen, E. K. Findlay, Sanford Gifford; Otolaryngology—Joseph Beck, chairman; Austin A. Hayden, Edward P. Norcross, S. J. Pearlman. The recommendations of these committees insure a worth while program of clinics and scientific sessions for all those interested in these specialties.

This year the College celebrates its twentieth anniversary, the first convocation having been held in Chicago in 1913. It will be recalled that the first Clinical Congress was held in this city in 1910 and was largely attended by enthusiastic surgeons from all parts of the United States and Canada.

SPECIAL FEATURES OF PROGRAM

In a symposium on Cancer is Curable on Wednesday afternoon at 2:30 eminent surgeons of wide experience in varied fields of surgical practice and from all parts of the United States and Canada will present their reports as to cases of cancer cured. A similar symposium at the Congress in St. Louis last year established a new viewpoint with the profession and the laity and created widespread favorable comment. Among the contributors will be Irvin Abell, M.D., Louisville; Frank K. Boland, M.D., Atlanta; Malvern B. Clopton, M.D., St. Louis; Charles A. Dukes, M.D., Oakland, Calif.; James Monroe Mason, M.D., Birmingham, Ala.; John T. Moore, M.D., Houston, Texas; Eugene H. Pool, M.D., New York; Richard R. Smith, M.D., Grand Rapids; E. Starr Judd, M.D., Rochester, Minn.,

Brooke M Anspach M.D Philadelphia William P Healy, M.D New York Martin B Tinker M.D Ithaca N.Y., William B Coley M.D New York Chevalier Jackson M.D Philadelphia.

A symposium on urologic surgery will be presented on Friday morning at 11 o'clock, the tentative program for which includes John R. Caulk M.D St. Louis on Cautey Removal of Prostatic Obstruction Frank Hinman M.D San Francisco "The Pathogenesis of Hydro-nephrosis" Joseph F. McCarthy M.D New York "The Prostate Gland—Its Place in General Medicine" Newer Conceptions of Diagnosis and Therapy.

Other important features of the general program for the Congress include (1) Conference on fractures arranged by the College Committee on the Treatment of Fractures to be held on Tuesday afternoon (2) a symposium under the auspices of the Board of Industrial and Traumatic Surgery on Friday afternoon (3) a symposium on teaching of surgery and surgical specialties on Thursday afternoon following the annual meeting.

EVENING MEETINGS

Programs for a series of five evening meetings will be held in the Ballroom of the Stevens Hotel are being prepared by the Central Executive Committee of the Congress. At the Presidential Meeting on Monday evening Dr. Philip H. Kreschmer chairman of the Committee on Arrangements, will welcome the visiting surgeons to Chicago, followed by Dr. Franklin H. Martin Director-General of the College who will introduce visiting surgeons from foreign countries, a large number of whom have been specially invited to attend the Congress this year. Among these will be Lord Moynihan of London, well known to most American surgeons. The address of the retiring president, Dr. J. Bentley Squier, of New York, will be followed by the inauguration of the president-elect, Dr. William D. Haggard, of Nashville Tennessee. The John B. Murphy oration in surgery will be delivered at this session by Dr. Loyal Davis, of Chicago.

The 1933 class of candidates will be received into Fellowship in the College at the annual convocation on Friday evening. On this occasion Dr. William D. Haggard will deliver the presidential address, and Robert Maynard Hutchins, A.M. LL.D. president of the University of Chicago the Fellowship address.

Distinguished surgeons of the United States and Canada, with visiting surgeons from foreign countries, have been invited to present papers dealing with surgical subjects of timely interest

at sessions on Tuesday Wednesday and Thursday evenings. Among the speakers will be the following: George W. Crile, M.D. Cleveland, on "Hyperthyroidism and Associated Diseases" Edward D. Churchill, M.D. Boston "Tumors of the Parathyroid Glands" Howard C. Naffziger M.D. San Francisco, "Treatment of Exophthalmos" George E. Brown, M.D., Rochester Minnesota, "Thrombo-Angiitis Obliterans" David Edwin Robertson, M.B. Toronto, "Sym-pathectomy in Children" Mont Rogers Reid M.D. Cincinnati, "Some Aspects of Vascular Diseases" Edgar L. Gilcrest, M.D. San Francisco, "The Common Syndrome of Rupture Dislocation and Elongation of the Biceps Brachii with an Analysis of Over Forty Cases."

Papers and discussions on subjects of special interest to ophthalmologists and otolaryngologists will be presented at two sessions on Tuesday and Thursday evenings.

THE HOSPITAL CONFERENCE

The opening session of the Congress—the annual hospital conference—will be held in the ballroom of the Stevens Hotel Monday morning beginning at 10 o'clock. An interesting program of papers, round table conferences and practical demonstrations dealing with the problems related to hospital efficiency is being prepared for this conference which will continue on Tuesday and Wednesday. Through a careful selection of the subjects to be presented by eminent surgeons and hospital executives, the College aims to make this year's program of wide interest and practical character—particular emphasis being directed toward professional standards and the vital problems related to medical economics. In recent years a greatly increased interest on the part of surgeons in both administrative and scientific phases of hospital work has been evidenced, and for this reason the program to be presented will be unique and provide discussions of importance to the three major hospital groups—medical, surgical and administrative. An opportunity will be afforded to all those interested in the scientific work of the hospital to participate in a program that pertains to the many and varied problems connected with the care of the patient.

HEADQUARTERS—HOTELS

General headquarters for the Clinical Congress will be established at the Stevens Hotel, located on Michigan Avenue between Seventh and Eighth Streets. This hotel affords unusual facilities for all activities of the Congress, as will be remembered by those who attended the Congress in

Chicago in 1929. The grand ballroom on the second floor with other large rooms on the third floor and the exhibition hall have been reserved for the exclusive use of the Congress. All of the evening sessions, the hospital conference on Monday, the annual meeting, the cancer and fracture symposia will be held in the grand ballroom. The registration and information bureau, together with the bulletin boards on which will be displayed the daily clinical program will be established in the exhibition hall in the basement, together with the Technical Exhibition.

Chicago has many fine, large hotels, several within walking distance of the headquarters hotel. A list of the hotels recommended by the Committee on Arrangements is presented here with. While Chicago's hotel facilities are very great and there should be no difficulty in securing first class hotel accommodations, it is advisable for those who expect to attend the Clinical Congress to reserve their hotel accommodations as far in advance as possible, as the Century of Progress Exposition will undoubtedly bring to Chicago a very large number of visitors.

The Technical Exhibition of the Clinical Congress will be located in the Exhibition Hall together with the registration and information bureau. In the same room will be found the bulletin boards on which the daily clinical programs will be posted each afternoon. The leading manufacturers of surgical instruments, X ray apparatus, operating room lights, hospital apparatus and supplies of all kinds, ligatures, dressings, pharmaceuticals and publishers of medical books will be represented in this exhibition.

We are assured that the railways of the United States and Canada will grant especially low rates on account of the Clinical Congress in connection with the Century of Progress Exposition in Chicago. Applications for reduced fares for this meeting are pending before the various railway traffic associations.

ADVANCE REGISTRATION

The hospitals of Chicago afford accommodations for a large number of visiting surgeons, but

CHICAGO HOTELS AND THEIR RATES

| | Minimum Rates With Bath | |
|--|----------------------------|--------|
| | Single | Double |
| Ambassador North State Street at Goethe | \$3 50 | \$6 00 |
| Auditorium Michigan Blvd. and Congress | 3 50 | 6 00 |
| Belden Stratford, 2300 Lincoln Park West | 4 00 | 6 00 |
| Belmont, Sheridan Road at Belmont | 4 00 | 5 00 |
| Bismarck, Randolph at LaSalle St. | 3 50 | 5 00 |
| Blackstone, Michigan Blvd. and 7th St. | 3 00 | 5 00 |
| Brevort, 120 West Madison St. | 2 50 | 3 50 |
| Congress, Michigan Blvd. and Congress | 4 00 | 6 00 |
| Drake, Lake Shore Drive and Michigan | 3 00 | 5 00 |
| Edgewater Beach, 5300 Sheridan Road | 4 00 | 6 00 |
| Great Northern, Jackson and Dearborn | 2 50 | 4 00 |
| LaSalle LaSalle at Madison St. | 1 50 | 4 00 |
| Morrison, 79 West Madison St. | 3 00 | 4 50 |
| Palmer House, State and Monroe Sts. | 3 50 | 6 00 |
| Pearson 190 East Pearson St. | 3 00 | 5 00 |
| Stevens Michigan Blvd. bet. 7th and 8th | 3 50 | 5 00 |

to insure against overcrowding the attendance will be limited to a number that can be comfortably accommodated at the clinics—the limit of attendance being based upon the results of a survey of the amphitheaters, operating rooms, and laboratories of the hospitals and medical schools to determine their capacity for visitors. It is expected, therefore that those surgeons who wish to attend the Clinical Congress in Chicago will register in advance.

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics and insures against overcrowding as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given.

A registration fee of \$5 00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card, which is non transferable, must be presented in order to secure clinic tickets and admission to the evening meetings.

PRELIMINARY CLINICAL PROGRAM

GENERAL SURGERY GYNECOLOGY OBSTETRICS ORTHOPEDICS UROLOGY
PROCTOLOGY SURGICAL PATHOLOGY ETC.

COOK COUNTY HOSPITAL

Monday

SOMMER L. KOCH—2. General surgery
F. H. FALLS—2. Gynecology
E. J. BEARKEHIMER—2. Orthopedics
WILLIAM R. CURRIE—2. General surgery
M. DAVISON—2. General surgery

Tuesday

SOMMER L. KOCH—9. Diagnostic clinic.
AARON KAMTER—9. General surgery
GEORGE DAVID—9. General surgery
A. H. MONTGOMERY—9. General surgery
A. H. COMLEY—9. Orthopedics
CAREY CULBERTSON—9. Gynecology
J. O'DONOGHUE—9. General surgery
HARRY CULVER—9. Urology
H. JACKSON—9. General surgery
MARCOUS HOBART—9. Orthopedics
VERNON C. DAVID—9. Diagnostic clinic
L. C. GATEWOOD—9. General surgery
J. P. GREENHILL—9. Gynecology
RALPH B. BETTMAN—9. Surgery in tuberculosis.
E. WARRENWEIL—9. General surgery

Wednesday

CHARLES B. BARTY—9. Gynecology
HARRY CULVER—9. General surgery
V. L. SCHRAGER—9. General surgery
GEORGE APPELBACH—9. General surgery
J. G. FROST—9. General surgery
R. C. SULLIVAN—9. General surgery
L. L. VINCEN—9. Urology
FRANK JERKA—9. General surgery
R. VAL HAN—9. General surgery
PHILIP H. KREUSCHER—9. Orthopedics
CHARLES M. MCKENNA—9. Urology
H. ROLICK—9. Urology
HARRY CULVER—9. Urology
GEORGE DAVID—9. General surgery
J. R. BUCHENBERGER—9. General surgery
DAVID HILL—9. Obstetrical operations.
SOMMER L. KOCH—9. General surgery

Thursday

PHILIP H. KREUSCHER—9. Orthopedics
CHARLES B. BARTY—9. General surgery
GEORGE DAVID—9. General surgery
R. W. MCNEALY—9. General surgery
MARCOUS HOBART—9. Orthopedics
D. HOBART—9. Gynecology
KARL A. MEYER—9. General surgery
E. W. FISCHMAN—9. Gynecology
A. H. MONTGOMERY—9. General surgery
MAX THURM—9. General surgery
A. H. COMLEY—9. Orthopedics
D. H. LEVINGDAL—9. Orthopedics
JOHN HARTER—9. General surgery
F. H. FALLS—2. Gynecology
E. J. BEARKEHIMER—2. Orthopedics.
RALPH BETTMAN—2. General thoracic surgery
WILLIAM R. CURRIE—2. General surgery

Friday

GEORGE APPELBACH—9. General surgery
AARON KAMTER—9. General surgery
R. C. SULLIVAN—9. General surgery
CAREY CULBERTSON—9. Gynecology
VERNON C. DAVID—9. General surgery
MARCOUS HOBART—9. Orthopedics
F. G. DYAS—9. General surgery
J. O'DONOGHUE—9. General surgery
H. JACKSON—9. General surgery
L. C. GATEWOOD—9. General surgery
JOHN HARTER—9. General surgery
J. R. BUCHENBERGER—9. General surgery
MARSHALL DAVISON—9. General surgery
E. WARRENWEIL—9. General surgery
SOMMER L. KOCH—9. General surgery

ST LUKE'S HOSPITAL

Monday

H. E. MOCK, A. REED MORROW and CHARLES SHAWK—
2. General surgical operations.
E. OLDRICK—2. Neurological surgery

Tuesday

H. O. JONES, WILLIAM P. CARROLL, M. J. KILLY, E. A. EDWARDS and JOHN BREWER—9. Gynecological operations: early human embryo, demonstration.
CARL HEDBLUM and WILLIAM VAN HAZEL—9. Thoracic surgery
H. E. MOCK—2. Reconstructive surgery
L. L. McARTHUR and S. W. McARTHUR—2. General surgery

Wednesday

L. E. SCHMIDT—9. Urological clinic.
E. W. RYERSON and F. A. CHANDLER—9. Orthopedic operations.
S. C. PLUMMER—9. General surgery
H. E. JONES and T. I. HANSEN—9. General surgery
E. W. RYERSON, R. O. RITTER and H. O. SORFIELD—2. Orthopedic operations.
FRANK E. DAVID, C. J. DEBIE and G. V. PORTER—2. Rectal surgery

Thursday

G. DETAKAT—9. Surgery in juvenile diabetes, ambulatory vein ligation of varicose veins.
H. E. MOCK—9. General surgery
HARRY CULVER—9. Urological clinic.
H. E. MOCK, A. REED MORROW and CHARLES SHAWK—2. Skull fractures.
W. R. CURRIE—2. General surgery
H. B. THOMAS and F. W. HARK—2. Orthopedic clinic

Friday

W. F. LYON—9. Dislocations of the shoulder with fracture of the greater trochanter
H. POTTS and F. W. MERRIFIELD—9. Ocul surgery operative.
E. W. RYERSON, F. A. CHANDLER and R. O. RITTER—2. Orthopedic clinic.

PASSAVANT MEMORIAL HOSPITAL—NORTH
WESTERN UNIVERSITY MEDICAL SCHOOL

Monday

RUDOLPH HOLMES and staff—2. Symposium on hyperemesis gravidarum.

Tuesday

LEANDER W. RIBA—9. The use of the electro-urethrotome in urethral strictures.

ARTHUR H. CURTIS and GEORGE H. GARDNER—9. Gynecological operations.

JOHN A. WOLFER—9. Cholecystitis, carcinoma of the colon.

JACOB R. BUCHENBERGER—9. Thyroid surgery

JOHN S. COULTER—10. Physical therapy

PAUL B. MAGNUSON—2. Ununited fracture of the neck of the femur bone graft in the spine.

JOHN A. WOLFER—2. Dry clinic. Alimentation of the critically ill patient by jejunal feedings.

Obstetrical Department—2. Symposium on cardiac diseases their obstetrical associations.

LOYAL DAVIS, LEWIS J. POLLOCK, HALE HAVEN and DAVID A. CLEVELAND—2. Symposium on neurologic surgery

Wednesday

HARRY M. RICHTER—9. Thyroid surgery

LOYAL DAVIS—9. Neurologic surgery

SUMNER L. KOCH and MICHAEL L. MASON—9. Nerve and tendon surgery of the hand.

JAMES T. CASE—10. Roentgenology

PHILIP H. KRETSCHMER—2. Hip joint surgery

ALLEN B. KAMAVEL, SUMNER L. KOCH and MICHAEL L. MASON—2. Review of twenty years of surgery of the hand.

LEANDER W. RIBA—2. Dry clinic. Prostatic resection.

EMIL D. W. HAUSER—2. Orthopedic surgery

Thursday

ARTHUR H. CURTIS and GEORGE H. GARDNER—9. Gynecological operations.

JOHN A. WOLFER—9. Cholecystitis, carcinoma of the breast.

JACOB R. BUCHENBERGER—9. Abdominal surgery

JOHN S. COULTER—10. Physical therapy

PHILIP H. KRETSCHMER—2. Shoulder and knee joint derangement.

RUDOLPH HOLMES and staff—2. Symposium on toxemias of late pregnancy renal and hepatic.

CHARLES A. ELLIOTT, WALTER H. NADLER, PAUL STARR, M. HERBERT BARKER, HOWARD B. CARROLL and HOWARD L. ALT—2. Symposium on hepatic disease.

Friday

HARRY M. RICHTER—9. Gastric surgery

LOYAL DAVIS—9. Neurologic surgery

SUMNER L. KOCH and MICHAEL L. MASON—9. Irradiation ulcers of the hand, Dupuytren's contracture.

JAMES T. CASE—10. Roentgenology

PAUL B. MAGNUSON—2. Demonstration of principles for overcoming deformity in ununited fractures before operation bone grafts for ununited fractures.

RUDOLPH HOLMES and staff—2. Obstetrical hemorrhages.

HARRY M. RICHTER, ANDREW C. IVY, SAMUEL J. FOGELSON and A. J. ATKINSON—2. Symposium on gastric ulcer

U. S. MARINE HOSPITAL

Wednesday

O. E. NADÉAU—9. General surgical clinic.

Friday

O. E. NADÉAU—9. General surgical clinic.

PRESBYTERIAN HOSPITAL

Tuesday

A. D. BEVAN—9. Surgery of the breast.

V. C. DAVID—9. Carcinoma of sigmoid

H. L. KRETSCHMER—9. Kidney surgery

R. H. HERBST—9. Transurethral electro resection of prostate gland.

KELLOGG SPEED—9. Tumors of chest wall, demonstration of cases, lantern slides.

A. H. MONTGOMERY—11. Abdominal surgery in children.

A. VERBRUGGEN—2. Neurosurgical operation.

Wednesday

A. D. BEVAN—9. Hernia and undescended testicle.

F. B. MOOREHEAD—9. Plastic surgery of mouth and face.

C. B. DAVIS—9. Tumors of the large intestine

H. L. KRETSCHMER—9. Surgery of the bladder

N. S. HEANEY—9. Vaginal surgery

DR. GATEWOOD—10. Carcinoma of stomach follow-up clinic.

E. M. MILLER—10. Thyroid surgery

H. A. OBERHELMAN—10. Surgery in diabetic patients.

E. R. MCCARTHY—11. Strangulated hernia in infants.

W. J. POTTS—12. Fracture problems.

Thursday

A. D. BEVAN—9. Surgery of gall bladder and bile tract.

H. L. KRETSCHMER—9. Transurethral resection of the prostate.

F. B. MOOREHEAD—9. Cleft palate surgery operative treatment of ankylosis of jaw

DR. GATEWOOD—9. Gastric resection for ulcer

R. H. HERBST—9. Diverticula of urinary bladder

R. H. HERBST and C. W. APPELBACH—9. Unusual urinary anomalies.

Staff—9. Dry clinic. E. D. ALLEN endometriosis. C. P. BAUER, dystocia. AARON KANTER, recognition of early carcinoma of uterus.

G. L. McWHORTER—10. Fracture of the greater tuberosity of the humerus.

A. VERBRUGGEN—10. Spinal cord injuries.

Friday

Staff—9. Dry clinic. A. D. BEVAN. Present status of anesthesia. H. L. KRETSCHMER. Genito-urinary surgery. R. C. BROWN. Treatment of massive hemorrhage in gastric ulcer. V. C. DAVID. Significance of polyps of large bowel. E. M. MILLER. Method of intravenous injection over long period of time. R. H. HERBST. Fibrosis of bladder neck. F. H. STRAUS. Obstructive jaundice. G. L. McWHORTER. Reconstruction of common bile duct, cases. M. L. LORING. Granuloma inguinale, cases. S. E. LAWTON. Cholecystenterostomy indications.

E. J. BERKHIMER—2. Orthopedic clinic.

WASHINGTON BOULEVARD HOSPITAL

Tuesday

PAUL C. FOX—9. Gynecological clinic.

Wednesday

A. R. METZ—9. General surgical clinic, presentation of unusual fractures.

Thursday

V. J. O'CONNOR—9. Hydronephrosis, etiology and treatment, case reports, X rays and operative results

suprapubic prostatectomy and transurethral resection of prostate comparatively indications and results.

MICHAEL REESE HOSPITAL

Tuesday

ALFRED A. STRAUSS, SEIGFRIED F. STRAUSS, JAMES PATTERJL and ROBERT A. CRAWFORD. Stomach resections for gastric and duodenal ulcer common duct choledochal anastomosis and gastro-entostomy for chronic obstructive jaundice.

GEORGE L. DAYTONPORT. Surgery of the common duct.

D. C. STRAUSS. Thyroid surgery.

E. FREED. General surgery surgery of the gall bladder.

BERNARD PORTIS. Thyroid surgery surgery of the rectum.

HARRY RICHTER. Thyroid surgery gall-bladder surgery.

MAX CUTLER. Surgery of the breast.

GUSTAV KOLLMER. Diathermy of bladder tumor nephrectomy for tuberculous.

IRVING KOLL. Electrical resection of prostate neophthotomy.

DANIEL H. LEVINTHAL. Internal derangements of the knee joint, removal of semi-lunar cartilage synovectomy for chronic arthritis bone lengthening operation.

JULIUS E. LACHNER. Abdominal hysterectomy interposition operation recto-vaginal fistula.

JOSEPH L. BAKER and RALPH REES. Complete perineal laceration, ovarian tumor and pelvic inflammation.

Wednesday

D. C. STRAUSS. Thyroid surgery gall-bladder surgery.

RALPH BETTMAN. Surgery of the chest.

GEORGE L. D. VINCIG. General surgery.

ALFRED A. STRAUSS, SEIGFRIED F. STRAUSS and ROBERT A. CRAWFORD. Sectional colectomy for ulcerative colitis and pyloplasty for congenital pyloric stenosis.

BERNARD PORTIS. General surgery and surgery of the colon.

MAX CUTLER. General surgery.

JAMES PATTERJL. General surgery.

JOSEPH EISENBAUM. Undescended testis suprapubic prostatectomy.

HARRY E. LACHNER. Electric resection of prostate pyelotomy for stones.

PHILIP LEWIN and SIDNEY SEIDMAN. Orthopedic clinic, shoulder elbow hand, hip pelvis.

I. E. FRANKENTHAL, Sr. and L. E. FRANKENTHAL, Jr. Gynecological operations.

W. H. ROBINSON. Obstetrical and gynecological clinic, demonstration of forceps, version and complete suture, episiotomy.

IRVING STEIN and M. L. LEVINTHAL. Obstetrical clinic, low cervical cesarean under local anesthesia.

Thursday

RALPH BETTMAN. Surgery of the gall bladder and common duct.

ALFRED A. STRAUSS, SEIGFRIED F. STRAUSS and ROBERT A. CRAWFORD. Surgical diathermy for carcinoma of the rectum resections for carcinoma of the stomach.

D. C. STRAUSS. Surgery of the colon, small intestine and thyroid.

GEORGE L. DAYTONPORT. Surgery of the common duct.

BERNARD PORTIS. General surgery.

SEIGFRIED F. STRAUSS. General surgery.

HARRY RICHTER. Surgery of the thyroid.

E. FREED. Surgery of the gall bladder and common duct.

ALFRED E. JOYCE. Nephrectomy for tuberculous kidney suprapubic prostatectomy.

IRVING SHAPIRO. Diathermy of bladder tumor nephrectomy for tumor of kidney.

DANIEL H. LEVINTHAL. Surgery of the spine, lesion operation for scoliosis and for tuberculous.

CHARLES M. JACOB. Orthopedic clinic.

JULIUS E. LACHNER. Gynecological operations.

JOSEPH L. BAKER and RALPH REES. Prolapse vaginal hysterectomy fibroids occiput posterior.

Friday

ALFRED A. STRAUSS, SEIGFRIED F. STRAUSS, JAMES PATTERJL and ROBERT A. CRAWFORD. Subtotal gastrectomy for gastropyloric ulcer resection of colon for carcinoma of colon.

D. C. STRAUSS. Surgery of the thyroid and general surgery.

GEORGE L. DAYTONPORT and RALPH BETTMAN. Gall-bladder surgery and surgery of the common duct.

RALPH BETTMAN. Thoracic surgery.

BERNARD PORTIS. Surgery of the colon and rectum.

MAX CUTLER. General surgery.

MAX CUTLER. Surgery of the breast use of radiotherapy in carcinoma.

FREDERICK LITENBERG. Suprapubic prostatectomy ureterotomy.

J. S. GROVE. Undescended testes.

PHILIP LEWIN and SIDNEY SEIDMAN. Orthopedic clinic, back, hip, knee, foot, shoulder demonstration of arthritis cases.

L. E. FRANKENTHAL, Sr. and L. E. FRANKENTHAL, Jr. Gynecological clinic.

W. H. ROBINSON. Gynecological clinic.

IRVING STEIN and M. L. LEVINTHAL. Gynecological clinic.

WOMEN AND CHILDREN'S HOSPITAL

Monday

FRANCIS FORD—2. X-ray therapy in malignancies.

Tuesday

BERTRA VAN HOOVER—9. General surgical operations.

JOSEPHINE MCCOLLUM and REBECCA VAN HOOVER—10. Demonstrations of morphine and scopolamine anesthesia in surgery.

O. ZELDENY—11. Demonstrations of electrocoagulation therapy.

Wednesday

PEARLE STETTLER—9. General surgical operations.

WALTERA KATIN and CLARA OCHS—10. Obstetrical cases, management under scopolamine anesthesia.

FRANCIS FORD—11. X-ray demonstrations.

PEARLE STETTLER—11. Surgical diagnosis of appendicitis in children.

Thursday

ALICE CORRIER—9. General surgery.

Staff—9. Fracture cases.

MARIE OCHS—10. Urological clinic.

AMELIA GHYOTAS—11. Carcinoma of the pelvis.

ELIOT PARSONS—11. Endocrine therapy in gynecological sterility operations.

Friday

MARY E. WILLIAMS—9. Gynecological operations.

CORINNE O'BRIEN—11. General surgical operations.

MARY SPACK and FLORENCE HARR—11. Obstetrics.

CHARLES FORD—11. X-ray and diathermy therapy.

EVANGELICAL HOSPITAL

G. EMMAN JOHNSON. Clinical studies of extra-uterine pregnancy.

PERRY L. HENDER. Clinical studies of pneumonia.

CHARLES PAPER. Treatment of lower limb fractures by fixed traction.

PAUL GEORGE PAPER. Demonstration of models and photographs showing newer methods of the handling of fractures of the maxilla and mandible.

MOUNT SINAI HOSPITAL

Tuesday

- V. L. SCHRAGER and associates—9. Hernia, breast and biliary surgery
ISRAEL DAVIDSOHN—11. Pathological demonstration
M. I. KAPLAN—11. X ray diagnosis and therapy
GUSTAV KOLINCHER and HARRY ROINICK—2. Genito-urinary surgery

Wednesday

- HARRY M. RICHTER and associates—9. Gastric and thyroid surgery
ISRAEL DAVIDSOHN—11. Pathological demonstration.
M. I. KAPLAN—11. X ray diagnosis and therapy
ALFRED A. STRAUSS—2. Gastro-intestinal surgery
RALPH B. BITTMAN and associates—2. Intrathoracic surgery operations.

Thursday

- AARON KANTER, A. F. LASH and associates—9. Gynecological operations.
ISRAEL DAVIDSOHN—11. Pathological demonstration.
M. I. KAPLAN—11. X ray diagnosis and therapy
CHARLES JACOBS and associates—2. Orthopedic operations.

Friday

- HARRY ROINICK—9. Genito-urinary surgery
ISRAEL DAVIDSOHN—11. Pathological demonstration.
M. I. KAPLAN—11. X ray diagnosis and therapy

Dry Clinics—Daily 9 and 2

- ISRAEL DAVIDSOHN. Value of biopsy in surgery
HENRY BUXBAUM. Toxemia of pregnancy
GUSTAV KOLINCHER. Electrosurgery in cancer therapy
AARON KANTER. Chord-epithelioma following a vesicular mole. functional uterine hemorrhage.
HARRY ROINICK. Bladder tumors.
A. F. LASH. Treatment of birth injury early diagnosis of uterine cancer
DAVID A. WILLIS. Relation of adrenals to thyrotoxicosis morbidity. In operation for acute appendicitis in relation to the question of drainage demonstration of a universal traction splint as used in a small hospital.
EMIL L. ALSON. Treatment of fracture of the mandible and mandible.
M. REBER GUTTMAN. Recent advances in the treatment of malignant diseases about the head and neck, endoscopic clinic.
Staff Symposium. Cancer of the lung. I. M. TRACZ, medical aspect. JACOB LUSCHUTZ, bronchoscopic aspect. ISRAEL DAVIDSOHN. pathological aspect. M. I. KAPLAN. X ray aspect.
MAURICE LEWISON. Medical appraisal of surgical risks.

ALBERT MERRITT BILLINGS HOSPITAL

- Staff—9. daily. General surgical operations and clinical demonstrations.
WILLIAM ADAMS. Demonstrations in thoracic surgery
EDWARD ANDREWS. Gall-bladder surgery
ALEXANDER BRUNSWICHT. Management of malignant tumors and experimental bone tumors.
E. L. COMPTON. C. H. HARTCHER and Dr. KRYES. Operations and demonstrations in orthopedic surgery
LESTER R. DRAGSTEDT. Surgery of the stomach and colon.
C. B. HUGGINS and H. E. HAYMOND. Operations and demonstrations in genito-urinary surgery
HILGER P. JENKINS. Abdominal surgery
D. B. PHENIXTER. Bone surgery operations and demonstrations.

ST MARY OF NAZARETH HOSPITAL

Monday

- A. S. SAMPOLINSKI—2. General surgical clinic.
E. H. WARSZEWI and P. F. CZEWALINSKI—2. Inguinal hernia clinic.
THAD LARKOWSKI—2. Demonstration of blood transfusion

Tuesday

- GEORGE MUKLER—9. General surgical clinic.
S. R. PIETKOWICZ—9. Spinal puncture and anesthesia—indications, contra indications, advantages, disadvantages, demonstrations.
C. C. BUCKWYSKI—2. Varicocele operations and demonstrations.
M. J. BADENHOWER and B. PIKORSKY—2. Goiter clinic, operations and demonstration of cases.

Wednesday

- T. Z. YELOWSKI—9. Gynecology and abdominal surgery
W. A. KUTLEWIKI—9. Emergency and general surgery
THOMAS PLANT—9. General surgery
A. A. THEDA—9. General surgery
FRANK TENZAR—9. General surgery
JOHN TOMKAR—9. General surgery
CHESTER CHALLENGER—9. X ray demonstration.
MICHAEL KUTZA—2. General surgery
F. A. MACKOWIAK—2. General surgery
M. E. UDMANSKI—2. Obstetrical clinic, low caesarean section.
M. KRUPINSKI—2. Removal of pilonidal cyst.

Thursday

- LEO CZAJA—9. Orthopedic clinic. maggot treatment of osteomyelitis.
E. MACDONALD—9. Abdominal surgery
H. H. HILL—9. Demonstration of pathological specimens.
A. V. PARTIFILLO—2. Aseptic resection of the bowel, demonstration of cases, moving picture exhibition.
M. E. UDMANSKI—2. Surgical anatomy of the peritoneum lantern slide demonstration

Friday

- JOSEPH WELFELD—9. Urological clinic.
GEORGE MUELLER—9. General surgery
CHESTER CHALLENGER—9. X ray demonstration.
H. H. HILL—9. Demonstration of pathological specimens
ROBERT E. FLANNERY—2. Gall bladder surgery
LEO P. KOZAKIEWICZ—2. Caesarean section indications, contra indications, demonstrations.

WESLEY MEMORIAL HOSPITAL

Monday

- P. B. MAGNUSON—2. Bone surgery

Tuesday

- R. W. MCNEALY—9. Gall bladder surgery gastro-intestinal surgery
C. B. REED—2. Obstetrical clinic, moving picture demonstration of breech delivery, perineorrhaphy and for ceps delivery: demonstration of external measurements of intra-uterine child.

Wednesday

- PHILIP H. KREUCHER—9. Joint surgery
GUY VAN ALSTYNE—9. Osteitis tuberculousa multiplex cystica (Jungling)

Thursday

- G. H. GARDNER and M. T. GOLDSTINE—9. Gynecological clinic, vaginal plastic work.

MERCY HOSPITAL

Tuesday

- F M BROWN—9. Malabsorption of the colon
 J L KELLY—9. Chronic intestinal fistula extensive central hernia.
 GEORGE GRUFFIN—9. Pyloric obstruction
 J D CLAMOND—9. Fractures and dislocations of the cervical spine.
 C J LARSEN—9. Rupture of the spleen stimulating acute appendicitis

Wednesday

- M F McGUIRE—9. Biliary tract surgery
 C F SAWYER—9. Acute pancreatitis perforating gastric and duodenal ulcers
 C L MARTIN—9. Anal histiocytomas in cases with postmenstrual tuberculous
 L E CARLSON—9. Carcinoma of the colon carcinoma of the breast
 HARRERT E L VOSE—9. Surgical anatomy of vesical orifice and urethral obstructions treatment of bladder tumors

Thursday

- L D MOOREHEAD—9. Thyroid gland, differential diagnosis of cases of dysthyroidism and hyperthyroidism with indication for operation and management
 W J PICKETT—9. Technical considerations a posterior gastro-enterostomy
 L D MYERS—9. Fracture cases
 F M DEBRUIN and F C VANCE—9. Gastro-intestinal clinic

Friday

- HARVEY SCHWITZ and HUBERT L. SCHWITZ—9. Gynecological clinic surgery and radiation therapy
 JOSEPH LARK—9. Carcinoma of the genito-urinary tract.
 A M. V. JAR—9. Cystic hygroma in an infant.

FRANCES E. WILLARD HOSPITAL

Tuesday

- ALLEN F. S. JEWARY—9. General surgical clinic
 FREDERICK M. YELDER—9. Surgery of bones and joints

Wednesday

- OTT M. WATTS—9. General surgical clinic
 VALENT L. SELLER—9. Diabetic clinic

Thursday

- JONAS F. J. ROW—9. Thyroid clinic

Friday

- VICTOR L. SCHWARTZ—9. General surgical clinic.

LIVINGLICKAL DEACONESS HOSPITAL

Tuesday

- EDWARD HEACOCK—9. General surgery

Wednesday

- PAUL MOORE—9. General surgery

Thursday

- A J SCHROEDER—9. Pelvic surgery

Friday

- JOHN PEARL—9. Abdominal surgery: spinal anesthesia.

RAVENSWOOD HOSPITAL

Tuesday

- G W GREEN—9. Gall-bladder surgery mortality and morbidity
 C A. BURWELL—9.30. Survey of cancer study organization in a private hospital.
 D B POYNT—9. Orthopedic surgery
 E W MULLER and J J MOORE—10.30. Carcinoma of testis
 M FIELD—1. Diagnosis and management of sterility
 L. C. FRISCH and D. L. JENNINGS—11.30. Gastric aphasia

Wednesday

- G DE TARNOWSKI and J J MOORE—9. Carcinoma of colon, modified Kraskie operation.
 J IRELAND—9.30. Fractures of the elbow
 R F WINTERMEYER—10. Emotions as etiological factors in hyperthyroidism.
 C H LOCKWOOD—10.5. Headaches.
 H P STODOLSKY—1. Blood transfusion.
 L C B. Y—1.15. Obstetrics.
 J F O'NEIL—1.30. Spinal anesthesia

Thursday

- C. C. RICHYER—9. Obstetrical anesthesia.
 W F GROFFEVOR—9.15. Carcinoma section.
 A C HANCOCK—9.30. Mental disturbances of diabetic patients
 A V BIRKHOFF—9.45. Indigestion
 F N BOWEN—9.45. Granulosa cell carcinoma of ovary
 R E DYER—10.30. Surgical technique
 P J S. BELL—1. Paraneoplastic abdominal incision.
 F B. VON NAMENSKI—1.5. Mortality in appendicitis
 C B WILLIAMS—1.30. Perthes disease fracture of spine.

SHIRINERS HOSPITAL

Tuesday

- BEVERIDGE MOORE and HAROLD SORFELD—9. Orthopedic operations

Wednesday

- BEVERIDGE MOORE—2. Demonstration of plaster technique club foot clinic

Thursday

- BEVERIDGE MOORE and H. ROLO SORFELD—9. Orthopedic operations.

Friday

- BEVERIDGE MOORE and H. ROLO SORFELD—2. Out-patient clinic.

SOUTH CHICAGO COMMUNITY HOSPITAL

Tuesday

- M E FISHER—1. Avertin anesthesia, analysis of 500 cases
 LOUIS D. SMITH—2.30. Tuberculosis of the kidney presentation of case

Friday

- JOSEPH J. LEBOWITZ—2. Fractures and dislocations of the elbow presentation of cases treated by open operation.
 FRANK G. MURPHY—2.30. Fractures of the upper end of the humerus, presentation of cases.
 GEORGE G. O'BRIEN—3. Postoperative exsiccation, presentation of case

JACKSON PARK HOSPITAL

Monday

F. L. BARBOUR—2 Dry clinic. Symposium on treatment of pulmonary tuberculosis, surgical and medical.

Tuesday

T. H. KELLEY—9. General surgical clinic.
ARRIE BAMBERGER—10. General surgical clinic.
C. C. CLARK—11. General surgical clinic.
S. B. MACLEOD—2. Fracture clinic.

Wednesday

ARRIE BAMBERGER—9. General surgical clinic.
H. HOYT COX—10. General surgical clinic.
S. W. MARCHEMONT ROBINSON—2 Dry clinic. Hand in sections as related to industrial surgery.
H. F. SPITZBERG—3. Mortality of appendicitis.

Thursday

ARRIE BAMBERGER—9. General surgical clinic.
T. H. KELLEY—10. General surgical clinic.
G. MARCHEMONT ROBINSON—11. Infection treatment of hemorrhoids.
E. ALLEN PAMBOX—12. Postoperative treatment of ruptured appendix with peritonitis.
R. T. FARLEY—1. Chono-epithelioma pseudo Addison's disease vulvulus.
J. J. MOORE—2. Gross surgical pathology.

Friday

A. F. HENDRINO—9. General surgical clinic.
GEORGE M. LUCAS—10. Gynecological surgery.
C. C. CLARK—11. General surgical clinic.

HOSPITAL OF ST. ANTHONY DE PADUA

Monday

THOMAS DWYER—2. Demonstrations in surgical pathology.

Tuesday

LAWRENCE RYAN—9. General surgery.
J. J. SPRAKES—9. General surgery.
O. J. JIRKA—9. Urology.
L. S. TICKE—2. X-ray demonstration.

Wednesday

R. C. CUPLER—9. General surgery.
JOSEPH ZABOKITSKY—9. General surgery.
F. W. SLOBE—2. Fracture clinic.
M. A. WEISSKOPF—2. Obstetrics.

Thursday

FRANK J. JIRKA—9. Abdominal operations.
F. B. OLENTINE and R. C. DUBRY—9. Thyroid surgery and general surgical clinic.
O. J. JIRKA—9. Urology.
L. S. TICKE—2. X-ray demonstration.

Friday

S. E. DOWLOW—9. General surgery.
A. A. BOXA—9. General surgery.
M. A. WEISSKOPF—9. Obstetrics.

HENROTIN HOSPITAL

Tuesday

CHAMMING BARRETT—9. Gynecological operations.
F. LEE STONE—9. Some problems in tubal patency.

Wednesday

JOHN A. GRAHAM—11. Open reduction of fractures.

COLUMBUS HOSPITAL

Tuesday

DANIEL A. ORTH, C. O. LINDSTROM and M. L. HANNAN—9. General surgery.
DANIEL A. ORTH—9. Indications and contra indications for spinal anesthesia.
CHAMMING BARRETT—9. Gynecological operations.
MINAS JOANNIDES—9. Collapse therapy in pulmonary tuberculosis.
M. J. SEIFERT—10. Surgical treatment of ulcer of the stomach.
MINAS JOANNIDES—2. Surgery of the chest.

Wednesday

CHAMMING BARRETT—9. Gynecological clinic.
G. N. BEZCHER and M. B. BURNS—9. Emergency surgery in industrial injuries.

Thursday

MINAS JOANNIDES—9. Surgical treatment of abscess of lung.
F. MUELLER and F. MUELLER, JR.—9. Transplantation of bone.
WILLIAM GEHL and T. L. CHENOWETH—9. Urological clinic.
G. N. BEZCHER and M. B. BURNS—9. Emergency surgery in industrial injuries.

Friday

DANIEL A. ORTH, C. O. LINDSTROM and M. L. HANNAN—9. General surgery.
M. J. SEIFERT—9. General surgery.

MUNICIPAL TUBERCULOSIS SANITARIUM

Tuesday

CLEMENT L. MARTIN—9. Perianal tuberculosis.
MINAS JOANNIDES—9. Thoracoplasty phrenic neurectomy.
HENRY C. SWZANY—11. Pathological conference demonstration of pathological specimens.

Wednesday

DORRIN F. RUDNICK—9. Nephrectomy for tuberculosis of kidney operative surgery for tuberculosis of the genitourinary tract.
FRANK FRIEDMEL and FRANK SZEJKA—10. Artificial pneumothorax.
FREDERICK TICE, ALLAN J. HRUBY and K. J. HENRICHSEN—2. Diagnostic clinic.

Thursday

JEROME HEAD and RICHARD DAVISON—9. Thoracoplasty pneumolysis, phrenic neurectomy.
K. J. HENRICHSEN—9. Artificial pneumothorax.

Friday

JEROME HEAD and K. J. HENRICHSEN—9. Surgical conference.

OUTPATIENT PNEUMOTHORAX CLINIC

2049 Washington Boulevard

MINAS JOANNIDES, E. L. QUINN, EMIL BUNTA and CLARA JACOBSON—9 and 2, daily. Artificial pneumothorax on ambulatory patients.

ALEXIAN BROTHERS HOSPITAL

Tuesday

MALCOLM L. HARRIS, AUGUST ZIMMERMAN, ROBERT FLANNERY and GEORGE L. APPELBACH—9. General surgery.
A. WOCHINSKI and EDWARD WHITE—9. General surgery.

CHICAGO MEMORIAL HOSPITAL

Monday

JULIA C. STRAWN and PAUL M. CLIVER—g. Gynecological clinic.

Tuesday

ARTHUR H. CONLEY and FRED M. MILLER—g. Orthopedic and industrial injury clinic.

JAMES E. FITZGERALD—g. Obstetrical clinic.

JOHN P. O'NEIL, J. WILLIAM PARKER and DOUGLAS F. ROBINSON—g. Urological clinic.

Wednesday

CHARLES E. KAMLER, LAWRENCE L. ISHAM, ROBERT A. MELLONY and M. L. WEINSTEIN—g. General surgical clinic.

FRANK WRIGHT—g. Colloidal status of the blood in post-operative pneumonia.

GEORGE M. LAUDAU—g. Phrenico sternum and treatment of unilateral tuberculosis.

Thursday

C. R. G. FORDSTER—g. Fracture clinic.

CARLOS M. ENOCSON—g. Oral and plastic surgery.

CHARLES J. DROVICH, Sr.—g. Proctology.

HARRY L. MEYER—g. Gynecological clinic.

WILLIAM L. BROWN—g. Radiology clinic.

Friday

PETER S. CLARK, BENNETT R. PARKER and LEO M. ZIMMERMAN—g. General surgical clinic.

ILLINOIS MASONIC HOSPITAL

Tuesday

E. WHITE—g. Prostatic surgery.

O. C. RITCHIE—g. Surgery of the kidney.

C. L. W. SAMPSON—g. Tumors of the testicle.

Wednesday

GILBERT FITZPATRICK—g. Obstetrical problems.

CHARLES PARKER and J. R. HARRIS—g. Gall-bladder problems.

CARL F. STEINBOCK—g. Medical consideration of thyroid disease.

HUGH MACKECKEY—g. Surgery of the thyroid.

Thursday

C. H. TIMMONS—g. Surgical considerations of peptic ulcer.

J. F. DAVIS—g. Surgery of the colon.

WALTER FRIEDRICH—g. Orthopedic problems of the foot.

ILLINOIS CENTRAL HOSPITAL

Tuesday

HUGH M. MACKECKEY—g. General surgery.

PHILIP H. KRECHMAYER—g. Orthopedics.

Wednesday

CHARLES FREITAG—g. General surgery.

BEVERIDGE MOORE—g. Orthopedics.

Thursday

S. CLIMONT HOGAN—g. General surgery.

VICTOR LEHNSCHLAGER—g. Genito-urinary surgery.

Friday

WILLIAM T. H. BISH—g. General surgery.

JAMES GILL—g. Neurologic surgery.

JOHN J. HILL—g. Obstetrics.

OSBERTON GUY and A. H. RAYCHER—g. Pathological conference.

AUGUSTANA HOSPITAL

Tuesday

N. M. PRINCE and O. E. NADIAU—g. Gitter and general surgical clinic.

Wednesday

A. T. LUNDGREN and EARL GARBER—g. General surgical clinic.

J. W. MYRUM—g. General surgical clinic.

R. J. COHEN—g. General surgical clinic.

Thursday

N. M. PRINCE and O. E. NADIAU—g. Gitter and general surgical clinic.

Friday

A. T. LUNDGREN and EARL GARBER—g. General surgical clinic.

J. W. MYRUM—g. General surgical clinic.

R. J. COHEN—g. General surgical clinic.

AMERICAN HOSPITAL

Tuesday

R. B. MALCOLM—g. Surgical clinic, tumors of the neck.

MAX THORNER and PHILIP THORNER—g. Surgical clinic, carcinoma of the rectum.

W. B. GERRARD—g. General surgical clinic.

FRANK E. SAMPSON—g. Radiology treatment of carcinoma of the mouth and tongue.

SOLOMON GREENSPAN and FREDERICK BOWEN—g. Management of placenta previa.

Wednesday

MAX THORNER and PHILIP THORNER—g. Surgery of the biliary tract.

HOMER E. TURNER and S. GREENSPAN—g. Casualty surgical clinic.

L. W. BEHRENDSEN, DAVID H. PARBOLL and LEON BERTLIN—g. Urological clinic.

FRANK E. SAMPSON—g. Radiological clinic, carcinoma of the breast and female genitalia.

Thursday

BENJAMIN GOLDSTEIN and JOHN F. PICK—g. Indications and technique for surgery of the chest.

FRANK E. SAMPSON—g. Radiological clinic, indications and contra-indications to radium treatment.

CHILDREN'S MEMORIAL HOSPITAL

Monday

FREMONT A. CRANDLER, CHARLES N. PRATT and FREDERICK REIDLER—g. Orthopedic clinic.

Tuesday

FREMONT A. CRANDLER, FREDERICK REIDLER and CHARLES PRATT—g. Orthopedic operations.

FREDERICK B. MOOREHEAD—g. Oral surgery operations and demonstration of cases.

Wednesday

ALBERT H. MONTGOMERY and staff—g. General surgery operations and demonstration of cases.

Thursday

HERMAN L. KRECHMAYER and staff—g. Urological surgery operations and demonstration of cases.

Friday

ALBERT H. MONTGOMERY and staff—g. General surgery operations and demonstration of cases.

CHICAGO LYING-IN HOSPITAL

Staff: FRED L. ADAMS, J. B. DELEZ, WILLIAM J. DIERCK, MARK M. EDWARD DAVIS, FRANK E. WHITAKER, MANUEL SPIEGEL and H. C. HESSELTINE.

Monday

Staff—2. Obstetrical operations, motion picture demonstration.

Tuesday

Staff—9. Obstetrical and gynecological operations.

Wednesday

Staff—9. Obstetrical and gynecological operations.
Staff—2. Obstetrical clinic, motion picture demonstration.

Thursday

Staff—9. Obstetrical and gynecological operations.
Staff—2. Obstetrical and gynecological dry clinic, motion picture demonstration.

Friday

Staff—9. Obstetrical and gynecological operations.
Staff—2. Obstetrical and gynecological dry clinic, motion picture demonstration.

RESEARCH AND EDUCATIONAL HOSPITAL

Monday

H. B. THOMAS—1. Orthopedic surgery

Tuesday

CARL A. HEDBLOM and WILLARD VAN HAEDEL—9. Thoracic and general surgery
L. S. SCHULTZ—9. Oral surgery

Wednesday

ERIC OLDBERG—9. Neurological surgery
R. B. MALCOLM—9. General surgery
H. B. THOMAS—1. Orthopedic surgery
F. H. FALLS—2. Obstetrical and gynecological clinic.

Thursday

CHARLES B. PUESTOW—9. General surgery
C. M. MCKINNA—10. Urological clinic cystoscopes.
WILLARD VAN HAEDEL—2. Thoracic surgery

Friday

CARL A. HEDBLOM and WILLARD VAN HAEDEL—9. Thoracic and general surgery
F. H. FALLS—2. Obstetrical and gynecological clinic.

POST-GRADUATE HOSPITAL

Monday

B. C. CUSHWAY—2. X-ray diagnosis.

Tuesday

H. SOLOWAY—10. Urological clinic.
EMIL RIES—10. Gynecological operations.
D. SCHLAPIK—2. Intraurethral prostatectomy moving picture demonstration.

Wednesday

J. C. BOODER—10. Rectal operations
LEO ZIMMERMAN—2. Phlebitis

Thursday

H. L. MEYERS—10. Gynecological operations.
R. A. LUTVENDIAHL—11. Gynecological clinic with colposcopic demonstration.

Friday

EMIL RIES—10. Gynecological operations.

SOUTH SHORE HOSPITAL

Tuesday

AXEL WIKELIUS—9. Gastric surgery
GEORGE G. O'BRIEN—11. General surgery
CLARENCE S. DUNKER and AXEL WIKELIUS—2. Symposium on gastric and duodenal ulcer

Wednesday

HUGH MACKECHNIE—9. Surgery of the colon.
FRANK G. MURPHY—11. Orthopedic clinic.
H. WILLIAM ELGHAMMER, GUY S. VAN ALSTYNE and PAUL R. CANNON—2. Symposium on intussusception

Thursday

LOUIS D. SMITH—9. Genito-urinary surgery
CLARA JACOBSON—2. Lung collapse procedures
C. C. MAHER—3. Cardiac risk in surgery

Friday

E. A. LUTTON—9. Gynecological clinic.
ANDREW DAHLBERG and WILLIAM HARRAHAM—11. Operative obstetrics.
H. R. COLVER—2. Industrial surgery
WALTER FISCHER—3. Foot problems.

JOHN B. MURPHY HOSPITAL

Monday

JOSEPH KERCKEN and R. J. MURPHY—2. Rectal treatment or appendical and other pelvic abscesses.

Tuesday

H. E. DAVIS—10. Studies of epiphyseal growth disturbances.

Wednesday

M. J. PURCELL—10. Emergency surgery
O. H. SCHULZ—10. Observations on treatment of pneumonia.

Thursday

F. O. BOWE—9. Treatment of puerperal infections.
H. R. KEMNEY and S. J. MARK—10. General surgery

Friday

A. C. GARVY—10. Diagnosis and treatment of skull fractures.
H. R. KEMNEY and S. J. MARK—10. Pre-operative treatment in abdominal cases.

GRANT HOSPITAL

Tuesday

ANDRE L. STAPLER—9. General surgery
F. H. FALLS—9. Gynecology
E. FISCHMANN—9. Vaginal hysterectomy
A. G. FREY—9. General surgery
GEORGE ANGLIO—9. General surgery
E. HESS—10. Urology

Wednesday

E. SEIDLER—9. Midtarsal resection
A. G. ZIMMERMAN—9. General surgery

Thursday

B. H. ORNDORFF—9. Electrosurgery
W. A. STUHR—9. General surgery
ANDRE L. STAPLER—2. General surgery

Friday

SYLVAN COOMBS—9. General surgery
E. W. FISCHMANN—9. Pus tubes.
A. G. ZIMMERMAN—9. General surgery

ST JOSEPH HOSPITAL

Monday

HUGH MCKENNA—2. Review of traumatic surgery with special reference to fractures

Tuesday

FRANKLIN B. MCCARTY—9. Surgical anatomy pathology and surgical treatment of diseases of the gall bladder
RALPH A. KORDENAT—2. Breast tumors

Wednesday

HUGH MCKENNA—9. Abdominal surgery surgery of the large intestine.
WALTER W. VOIGT—9. Puerperal sepsis
THOMAS J. O'DONOGHUE—2. Obstetrical and gynecological operations

Thursday

WILLIAM H. G. LOGAN—9. Cleft palate and cleft lip operations
RALPH A. KORDENAT—2. Gall-bladder surgery

Friday

L. WADE MARTIN—9. Obstetrical clinic

OAK PARK HOSPITAL

Tuesday

JOHN W. TOPE—9. General surgery
GORDON SWANSON—9. Orthopedic clinic
ARTHUR COBLE—9. Management of fractures of the femur

Wednesday

RALPH MULLER—9. General surgical clinic treatment of peptic ulcer
CHARLES FOX—9. Gynecological operations
CARL UTHOFF—9. Operative cystoscopy

Thursday

LOUIS RIVER—9. General surgery
ADOLPH KRAFFT—9. General surgery
CARL UTHOFF—9. Genito-urinary operations

Friday

JOHN W. TOPE—9. General surgery
MILFORD MURK—9. Gynecological operations

WEST SUBURBAN HOSPITAL

Monday

HARRY J. DOOLEY—9. Urological clinic.

Tuesday

WILLIAM J. POTTS—9. The healing of fractures
OSCAR B. FUCHSBERGER—9. Gall-bladder surgery
THOMAS I. MOTTER—9. General surgery
JAMES H. SKILLER—9. Gynecological clinic.

Wednesday

JOSEPH L. NORTON—9. General surgery
FREDERICK H. FALLER—9. Gynecological clinic.

Thursday

CHARLES E. HUMISTON—9. General surgery
WARD L. POTTER—9. Thyroid clinic.
LOUIS FAULKNER—9. Interesting obstetrical conditions.
PAUL C. FOX—9. Gynecological clinic.
EUGENE C. PIETTE—9. Pathological demonstration
HOWARD HUMISTON—2. Urological clinic.

ST ANNE'S HOSPITAL

Tuesday

T. E. MEANY—9. Orthopedic clinic.
J. L. KRAFFT—11. General surgery
J. B. HANCOCK—2. X-ray demonstration.

Wednesday

G. F. THOMPSON—9. Stomach and intestinal surgery
J. W. MCCONNELL—10. Gynecology
J. J. GRADIN—11. General surgery

Thursday

H. J. DOOLEY—9. Urological clinic.
E. P. VACOMAN—9. Gall-bladder surgery
E. P. GRAMER—10. Treatment of head injuries
J. L. FLEMING—11. Pathological obstetrics.

Friday

B. W. JACK—9. General surgery
Staff—9. Clinical meeting
D. F. HAYES—11. General surgery
L. R. HILL—2. Pathological demonstration.

HOLY CROSS HOSPITAL

Tuesday

J. FRANCIS RUTCH—9. Gynecological operations cholecystectomy high spinal anesthesia.
E. R. CROWDER—9. Some practical considerations regarding the Graham test.
JOHN F. DYBALSKI—10. Hysterectomy spinal anesthesia
VINCENT TOMCIVANSKI—11. Appendectomy

Wednesday

DONALD MONACO—9. Thyroidectomy lecture on avertin anesthesia.
A. R. McCRADIE—9. Hernia operation.
PAUL LAWLER—11. Low cervical cancerous section.

Thursday

STEPHEN BURNS—9. Gynecological operations.
MICHAEL SERIOL—9. Cholecystectomy
F. F. FRAIDEN—11. Panhysterectomy

Friday

M. J. BARDACHOWSKI—9. Thyroidectomy hysterectomy
RICHARD ROCHER—9. Herniorrhaphy
J. FRANCIS RUTCH—11. Pre- and postoperative therapy

GARFIELD PARK HOSPITAL

Tuesday

JOHN R. HARGER and SAM PLECK—9. Surgery of the stomach treatment of peptic ulcer
L. F. MACDIARMID—9. General surgery

Wednesday

CLAUDE WEIDY and JOHN H. PROCK—9. Abdominal surgery

Thursday

J. M. BERGER and FRANK CHAUVET—9. General surgery

Friday

CLARENCE SAELENUT—9. Diaplastic strains of bacteria from renal lesions, experimental production of leukosis with spiroplasma (spirochaeta pallida)
VINCENT J. O'CONNOR—9. Tuberculosis of kidney with review of cases hydrocephalus plastic repair of nephropathy

EVANSTON HOSPITAL

Monday

JAMES T. CASE—2. X-ray diagnosis and therapy

Tuesday

WILLIAM R. PARKES—9. Thyroid clinic.

MARCOUS H. HONART—9. General surgical clinic.

DWIGHT F. CLARK—2. Recent advances in the treatment of common fractures.

MARCOUS H. HONART—2. Fracture clinic.

Wednesday

WILLIAM C. DANFORTH—9. Gynecological operations.

CHARLES E. GALLOWAY—9. Gynecological operations.

JEROME R. HEAD—9. Thoracic surgery.

FREDERICK CHRISTOPHER—2. Demonstration of surgical cases.

ROBERT C. LONGERGAN—2. Demonstration of orthopedic cases.

Thursday

WILLIAM C. DANFORTH—9. Gynecological operations.

JOHN L. PORTER—9. Orthopedic operations.

WILLIAM C. DANFORTH—2. Obstetrical clinic.

CHARLES E. GALLOWAY—2. Schiller test for the early diagnosis of carcinoma of the cervix.

Friday

FREDERICK CHRISTOPHER—9. General surgical clinic.

FRANK D. GURN—9. Demonstration of surgical pathology.

CHARLES E. POPE—9. Proctological clinic.

J. EVERETT SAUNDERS—2. Urological clinic.

LUTHERAN DEACONESS HOSPITAL

Tuesday

GEORGE H. SCHROEDER, JOHN KOUCKY, H. C. WALLACE and G. H. MAMMEN—9. General surgical clinic.

Wednesday

GEORGE H. SCHROEDER, JOHN KOUCKY, H. C. WALLACE, G. H. MAMMEN, R. G. WILLY and G. O. SOLEM—9. Clinical demonstrations.

Thursday

GEORGE H. SCHROEDER, JOHN KOUCKY, H. C. WALLACE and G. H. MAMMEN—9. General surgical clinic.

Friday

GEORGE H. SCHROEDER, JOHN KOUCKY, H. C. WALLACE, G. H. MAMMEN, R. G. WILLY and G. O. SOLEM—9. Clinical demonstrations.

ST BERNARD'S HOSPITAL

Monday

W. G. ERSTEIN—2. General surgery.

Tuesday

W. J. MULHOLLAND—9. General surgery.

H. HORMAN—9. General surgery.

G. M. CURRING—2. General surgery.

L. B. DOYLE—2. Genito-urinary surgery.

Wednesday

B. C. CUSHWAY and R. J. BLAIR—9. Roentgenological demonstration of anomalies of spine.

J. B. HAEBERLIN—9. General surgery.

W. S. HECTOR—9. General surgery.

J. A. PARKER—2. General surgery.

S. L. GOVERNALE and S. S. MARKIEWICZ—2. Gastro-intestinal operations.

Thursday

J. T. MEYER—9. Thyroid surgery.

F. M. PHILPER—9. Genito-urinary surgery.

W. P. GURN—9. Gynecological operations.

D. A. VLOEDMAN—2. Gynecological operations.

C. C. GUY—2. Demonstration of unusual specimens.

Friday

A. E. MCCRAID—9. General surgery.

E. A. RACE and F. J. STUCKER—9. Operative obstetrical problems.

LITTLE COMPANY OF MARY HOSPITAL

Monday

W. D. STADLE—2. Management of eclamptic patients.

Tuesday

L. L. CHAMPIER—9. Management of fractures about the elbow.

J. E. LAIBR—10. Treatment of carcinoma of the bladder.

Wednesday

E. D. HUNTINGTON—9. Gastro-intestinal surgery complications.

Thursday

L. L. CHAMPIER—9. Management of compound fractures.

W. A. MALONE—10. Radium treatment of carcinoma of the cervix.

Friday

A. W. WOODS—9. Gynecological repair operations.

E. D. HUNTINGTON—10. Intestinal obstruction.

SURGERY OF THE EYE EAR NOSE AND THROAT

RESEARCH AND EDUCATIONAL HOSPITAL

Otolaryngological Staff: F. L. LEBERER, W. H. THEOBALD, J. J. TREDGOLD, G. S. LIVINGSTON, E. A. BREIDEN, N. FOX, S. L. SHAPIRO, I. G. SPIEGELMAN, P. A. HALPER, A. C. KAMEL, A. COONER, J. HARKIN, O. VAN ALSTAY, M. GUTTMAN, S. MORWITZ, M. OSTRON, B. LAW BRACKER, L. HARTLETT, H. KILWANE, L. FRIEDMAN, H. WADSWORTH, J. BIELLOWS and N. FAIRBANKS
 Ophthalmological Staff: HALLARD BRAND, M. L. FOLK, H. J. SMITH, S. WOLF, S. KAUFMAN, CARL APPLE and J. W. CLARK.

Monday

Staff—1 Otolaryngological out-patient clinic

Tuesday

Staff—9 Ophthalmological clinic, operations and demonstrations

Staff—0 Otolaryngological out-patient clinic

Staff—1 Otolaryngological clinic, operation and demonstrations

Wednesday

Staff—0 Eye clinic

Staff—0 Otolaryngological out-patient clinic.

Staff—2 Otolaryngological out-patient clinic.

Staff—4 Otolaryngological seminar

Thursday

Staff—9 Otolaryngological operations

Staff—9 Eye clinic

Staff—0 Otolaryngological out-patient clinic

Staff—0 Otolaryngological clinic, operations and demonstrations

Staff—0 Otolaryngological out-patient clinic

Friday

Staff—0 Eye clinic, operations and demonstrations.

Staff—10 Otolaryngological out-patient clinic.

Staff—0 Otolaryngological out-patient clinic.

MERCY HOSPITAL

Tuesday

GEORGE T. JORDAN—9 Nasal gungion.

L. C. HOFFMAN—9 Cataract extractions

C. H. CHRISTOPHER—9 Bronchoscopy

Wednesday

GEORGE MURGRAVE and ALFRED PASELEY—9 Frontal sinus operation, local anesthesia, modified radical mastoid operation with complete removal of flap presentation of cases

Thursday

ULYSES J. GREE—9 Radical antrum and mastoid.

DEMO O'CONNOR and RAY KIRKMAN—9. Ocular tumors.

CARL SCHRAM—9. Focal infection in litta.

EVANSTON HOSPITAL

Tuesday

THOMAS C. GALLOWAY—9. Otolaryngological clinic.

Thursday

HOWARD C. BALLINGER—9 Otolaryngological clinic.

Friday

GAIL R. SOWER—2. Lesions of the fundus oculi, lantern slide demonstration.

PRESBYTERIAN HOSPITAL AND RUSH MEDICAL COLLEGE

Monday

D. B. HAYDEN—2. Complications of otitis media without rupture of the tympanic membrane.

E. W. HARRISON—2. Unusual laryngeal and bronchial case.

GEORGE E. SHAMBERGER, JR. and E. W. HARRISON—2. Operations on the testis for dacryocystitis.

MAX JACOBSON—3. Neurological aspects.

Tuesday

ROBERT VON DER HEYDT—3. Shat lamp diagnostic clinic.

Wednesday

VERNON LEECH—3. Glaucoma.

Thursday

BERTHA KLEIN—0. Histopathology of fundus

T. W. LEWIS—2. Discussion of some difficult problems in the operation for correction of the nasal septum.

L. T. COOPER—2. Demonstration of skiagraphs of the sinuses and mastoids.

R. W. WATKINS—2. Nasal findings in allergic cases.

W. J. JONKER—2. Diathermy and its application to the treatment of nose and throat conditions.

Friday

W. F. MCKENNEY—10. External diseases of the eye and trichocystitis

ELIAS SELINGER—3. Fundus.

ILLINOIS EYE AND EAR INFIRMARY

Tuesday

DWIGHT C. OLCUTT—9. Use of flap in cataract work; superior rectus tension suture; plastic.

LEROY THOMPSON—9. Industrial ophthalmology

CARL H. CHRISTOPHER—10. Bronchoscopy; esophagoscopy

M. A. GLATT—1. Radical mastoid and radical frontal operations.

OSCAR CLEFF—3. Radical mastoid operation.

E. R. CROSBY—2. Intra- and extra-ocular surgery

Wednesday

M. LEBENSON—9. Detachment of retina, cataracts, trichiasis.

Staff—10. Dry clinic.

ULYSES J. GREE—1. Radical mastoid and radical antrum operations.

MICHAEL GOLDBERG—2. Iridotomies operation for glaucoma, cataracts; controlled tenotomy

JOHN A. CAVANAGH—3. Radical mastoid operation.

Thursday

HERBERT WALKER—9. Detachment of retina, Lenses operation.

C. F. YERGEN—10. Radical sinus and radical mastoid operations

A. LEWIS—1. Radical frontal operation.

E. K. FROST—2. Intra- and extra-ocular surgery

W. A. GROSS—3. Tonsils, diathermy

RAVENSWOOD HOSPITAL

Wednesday

A. N. MURRAY—10:30. Malignancies of the eye.

CHICAGO EYE, EAR, NOSE AND THROAT HOSPITAL

Tuesday

- H. B. FULLER—9. Mastoid surgery
 WILLIAM A. HOFFMAN and WILLIAM LINGARD—9 Ear nose and throat clinic.
 WILLIAM A. FISHER—9. Cataract operations.
 WILLIAM A. HOFFMAN—9. Eye clinic.
 L. SAVITT—10. Removal of tonsils by diathermy
 OSCAR B. NUENT—11 Eye clinic.
 O. M. STEFFENSON—11 Ear nose and throat clinic.
 T. S. KAMMERLING—2. Eye, ear nose and throat clinic.

Wednesday

- O. M. STEFFENSON—9. Tonsil dissection.
 WILLIAM A. HOFFMAN and WILLIAM LINGARD—9. Nasal surgery and ear nose and throat clinic.
 OSCAR B. NUENT—9. Cataract operations.
 WILLIAM A. HOFFMAN—9. Eye clinic.
 OSCAR B. NUENT—11 Eye clinic.
 O. M. STEFFENSON—11 Ear nose and throat clinic.
 L. SAVITT—11 Ear nose and throat clinic.
 H. B. FULLER—2 Eye ear nose and throat clinic.

Thursday

- WILLIAM A. FISHER—9. Eye operations.
 WILLIAM A. HOFFMAN—9. Eye clinic.
 T. S. KAMMERLING—9. Surgery of the nasal accessory sinuses.
 WILLIAM A. HOFFMAN and WILLIAM LINGARD—9. Ear nose and throat clinic.
 L. SAVITT—10. Physical measures in otolaryngology
 O. M. STEFFENSON—11 Ear nose and throat clinic.
 L. SAVITT—11 Ear nose and throat clinic.
 OSCAR B. NUENT—11 Eye clinic.
 T. S. KAMMERLING—2 Eye, ear nose and throat clinic.

Friday

- O. M. STEFFENSON—9. Tonsil dissection.
 WILLIAM A. HOFFMAN and WILLIAM LINGARD—9. Ear nose and throat clinic.
 OSCAR B. NUENT—9. Fundus photography and pathology
 WILLIAM A. HOFFMAN—9. Eye clinic.
 H. B. FULLER—10. Functional testing
 O. M. STEFFENSON—11 Ear nose and throat clinic.
 OSCAR B. NUENT—11 Eye clinic.
 H. B. FULLER—2 Eye ear nose and throat clinic.

MICHAEL REESE HOSPITAL

Monday

- H. S. GRADLE—2:30. Eye surgery

Tuesday

- S. J. PEARLMAN—9. Bronchoscopic clinic.
 M. L. FOLK—2 Eye surgery

Wednesday

- SAMUEL SALINGER—9. Nasal fractures, plastic of the nose.
 M. L. FOLK—2. Eye clinic.
 H. S. GRADLE—2:30 Surgical eye clinic.
 ROBERT VON DER HEYDT—3. Slit lamp demonstration

Thursday

- CASPER EPSTEIN—9. Cleft palate and harelip.
 S. J. MEYER—2. Eye clinic.

ALBERT MERRITT BILLINGS HOSPITAL

Tuesday

- E. V. L. BROWN—9. Eye clinic.
 J. R. LINDSAY—10:30. Ear, nose and throat clinic.
 DEWEY KATZ—2 Eye clinic.

Wednesday

- LOUIS BOTTMAN—9 Eye clinic.
 T. E. WALSH—10:30. Ear nose and throat clinic.
 JOHN STOUGH—2 Eye clinic.
 J. R. LINDSAY and G. H. SCOTT—2 Ear nose and throat operations.

Thursday

- P. C. KRONFELD—9. Eye clinic.
 G. H. SCOTT and H. B. PERLMAN—10:30 Ear nose and throat clinic.
 DEWEY KATZ—2 Eye clinic.

Friday

- DEWEY KATZ—9. Eye clinic.
 J. R. LINDSAY and T. E. WALSH—10:30. Ear nose and throat clinic.
 P. C. KRONFELD—2 Eye clinic.
 T. E. WALSH and H. B. PERLMAN—2. Ear nose and throat operations.

COOK COUNTY HOSPITAL

Monday

- EARLE B. FOWLER—2. Ophthalmoscopy
 S. PEARLMAN and N. LEXSHIN—2. Esophagoscopy and bronchoscopy—surgery of the neck.

Tuesday

- THOMAS D. ALLEN—2. External diseases of the eye.
 I. MURKAT—2. Clinical and surgical otolaryngology—plastic surgery of face and nose.

Wednesday

- L. T. CURRY—9. Otolaryngology clinical and surgical cases.
 WILLIAM F. MONCRIEFF—9. Ophthalmic neurology and ophthalmoscopy

Thursday

- SAMFORD R. GIFFORD—9 Ophthalmic surgery
 CHARLES F. YERGER—11 External diseases of the eye.
 S. PEARLMAN and N. LEXSHIN—2. Esophagoscopy and bronchoscopy—surgery of the neck.

Friday

- T. C. GALLOWAY and M. T. LAMPERT—10. Malignancy about the head, diathermy
 THOMAS D. ALLEN—2 Ophthalmic surgery
 I. MURKAT—2. Clinical and surgical otolaryngology plastic surgery of face and nose.

COLUMBUS HOSPITAL

Monday

- MICHAEL GOLDENBURG—2. Emergency surgery of the eye

Wednesday

- G. B. LAMBRACK—9. Indications for operative treatment in acute mastoiditis.
 S. CHIARETTA—9 Otolaryngological clinic.
 MICHAEL GOLDENBURG—2. Eye surgery

Friday

- MICHAEL GOLDENBURG—2 Eye surgery

ST LUKE'S HOSPITAL

Monday

EVEL VIERHOFF—L. Ophthalmological clinic.

Tuesday

E. FIDLEY and RICHARD GAMBLE—1 Ophthalmological clinic.

J. T. CAMPBELL, JOHN A. CAVANAUGH, HORACE R. LYONS, E. P. NORCROSS and WALTER H. THEOBALD—2. Otolaryngological clinic.

Wednesday

ALVA SOWERS—L. Ophthalmological clinic.

J. T. CAMPBELL, JOHN A. CAVANAUGH, HORACE R. LYONS, E. P. NORCROSS and WALTER H. THEOBALD—3 Otolaryngological clinic.

Thursday

FRANK BRAWLEY and JAMES W. CLARK—Ophthalmological clinic.

J. T. CAMPBELL, JOHN A. CAVANAUGH, HORACE R. LYONS, E. P. NORCROSS and WALTER H. THEOBALD—2 Otolaryngological clinic.

Friday

E. FIDLEY and RICHARD GAMBLE—Ophthalmological clinic.

JOHN B. MURPHY HOSPITAL

Monday

E. F. GARRAGHAN—2 Eye operations.

Tuesday

L. H. WOLF and PAUL WOLF—O Mastoid surgery.

Friday

GEORGE W. MANORBY—O Cataracts.

CHILDREN'S MEMORIAL HOSPITAL

Wednesday

GEORGE S. LIVINGSTON and staff—O Otolaryngological clinic.

RICHARD C. GAMBLE and staff—2 Ophthalmological clinic.

WASHINGTON BOULEVARD HOSPITAL

Tuesday

L. MCBRIDE—Nose and throat clinic.

Wednesday

VIRGIL WESCOTT—2. Eye clinic.

ILLINOIS CENTRAL HOSPITAL

Tuesday

HIDAM SMITH—O. Eye clinic.

Wednesday

JAMES H. McLAUGHLIN—O. Nose and throat surgery.

GRANT HOSPITAL

Wednesday

S. H. SCHOFFER—O. Ear, nose and throat clinic.

GEORGE F. SUTHER—O. Eye clinic.

GEORGE DICKER—O. Eye, ear, nose and throat clinic.

MOUNT SINAI HOSPITAL

Monday

JOSEPH C. BECK, ALFRED LEWY, NOAH SCHOOLMAN, JACOB LIFSCHUTZ, S. M. MORWITZ and associates—2. Ear, nose and throat operations.

Friday

JOSEPH C. BECK, ALFRED LEWY, JACOB LIFSCHUTZ, NOAH SCHOOLMAN, S. M. MORWITZ and associates—O. Ear, nose and throat operations.

JAMES E. LESCHENBERG—O. Operations for cataract and squint.

*Daily 9 and 2*JAMES E. LESCHENBERG—Eye changes in hypertensive states.
ALFRED LEWY and S. M. MORWITZ—Orogenic sepsis.

OAK PARK HOSPITAL

Tuesday

HOWARD RIORDAN—O. Demonstration of new naso-pharyngoscope on the cadaver and living.

Thursday

HOWARD RIORDAN—O. Treatment of maxillary sinusitis with the cold quartz lamp; new method of treatment of maxillary polyp by diathermy.

Friday

GEORGE H. THEOBALD—O. Demonstration of eye tumors; ophthalmic surgery.

CHICAGO MEMORIAL HOSPITAL

Monday

RICHARD H. STREET and RICHARD W. WATKINS—2. Otolaryngological clinic.

Tuesday

HERMAN P. DAVIDSON and GLENWAY W. NETHERCUT—O. Eye clinic.

Wednesday

ALFRED F. LEWY and IRVING L. MORGENTHAU—2. Otolaryngological clinic.

WEST SUBURBAN HOSPITAL

Monday

ROBERT H. GOOD—2. Surgery of the nose, motion picture demonstration.

Tuesday

JOHN J. THEOBALD—2. Mastoid surgery.

Wednesday

GEORGE H. THEOBALD—2. Eye pathological exhibit.

AMERICAN HOSPITAL

Tuesday

HARRY L. POLLOCK and ASSOCIATES—2. Ear, nose and throat clinic.

Wednesday

OSCAR KRAFT—2. Ophthalmological clinic.

AUGUSTANA HOSPITAL

Wednesday

ALFRED MURRAY—O. Eye, ear, nose and throat clinic.

WOMEN AND CHILDREN'S HOSPITAL

Tuesday

ALICE K. HALL—10. Nose and throat clinic.

Wednesday

FRANCES HAINES—10. Nose and throat clinic.

PASSAVANT MEMORIAL HOSPITAL

Friday

J. GORDON WILSON, JOHN DELPH, CARL BOOKWALTER and
ELLISON ROSS—9. Ear, nose and throat clinic.
SAMFORD GIFFORD, WILLIAM MASON JR. and RALPH DAVIS
—11. Ophthalmology

ILLINOIS MASONIC HOSPITAL

Tuesday

M. H. COTTE—10. Some advances in mastoid work.
B. M. WOLFE—10. Tonsil surgery in the poor risk cases.
H. E. TAYLOR—10. Conservative surgery of the nose.

EVANGELICAL HOSPITAL

G. HENRY MUMFORD. Technique and interpretation of hearing tests and technique and interpretation of tests of the static labyrinth.

ST. BERNARD'S HOSPITAL

Friday

PHILIP O. COXSON—2. Surgery of the eye, dry clinic.

LITTLE COMPANY OF MARY HOSPITAL

Wednesday

H. T. NASH—10. Emergency surgery of the eye.

SOUTH SHORE HOSPITAL

Monday

JOHN W. STANTON—2. Mastoiditis and its complications.

Thursday

JOHN W. STANTON—11. Otolaryngological surgery

ST. ANNE'S HOSPITAL

Tuesday

B. T. GORDON—9. Nose and throat clinic.

Wednesday

W. K. GRAY—9. Eye and ear clinic.

ST. MARY OF NAZARETH HOSPITAL

Tuesday

J. J. KILLIEN—9. Ear, nose and throat clinic.

Thursday

J. J. KILLIEN—9. Ear, nose and throat clinic.

SOUTH CHICAGO COMMUNITY HOSPITAL

Tuesday

GEORGE E. PARK—3. The center of ocular rotation in the horizontal plane.

JACKSON PARK HOSPITAL

Tuesday

H. E. L. THOM—1. Timm's modification of Sluder tonsillectomy

FRANCES E. WILLARD HOSPITAL

Thursday

WILLARD D. BRODIE—10. Surgery of throat and nose.

SURGERY, GYNECOLOGY AND OBSTETRICS

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SACRO-ILIAC ARTHRITIS

THEODORE A. WILLIS, A. M. M. D., F. A. C. S. CLEVELAND, OHIO
From the Anatomical Laboratory Western Reserve University

SEVERAL years ago in discussing age changes as found in macerated skeletons the writer made the statement that the sacro-iliacs were ankylosed by bone productive changes more frequently than any other joints, and that they were often completely fixed when the other parts of the same skeleton showed little if any similar change.

A recent review of 1559 human skeletons in the Hamann Museum of Anthropology disclosed 96 in which one or both sacro-iliac joints are firmly ankylosed by calcification of ligaments and bone lipping. The material of this museum is collected through the dissecting room, the city morgue, and various city and county institutions. It consists mostly of those individuals of various races who have failed to make a place for themselves in the local social arrangement, and therefore probably presents a higher incidence of disease and defect than a true cross section of the local population.

In addition to the 96 specimens showing complete sacro-iliac ankylosis, a much greater number presented similar bone changes not of sufficient degree to resist disarticulation during maceration.

A most arresting feature of the osteogenic changes was the occurrence of two types developing independently. Sometimes a skeleton shows one type alone, but more often the two are co-existent. The one is a smooth calcifica-

tion of the anterior sacro-iliac ligament, the other an irregular lipping at the joint periphery. The former is present in younger subjects, often involves other parts of the spinal column but not the skeleton in general, and is a true spondylitis of the axial skeleton. The latter is predominant in older individuals, a hypertrophic type usually of general distribution through the entire skeleton. A few specimens were found which showed complete obliteration of the joint with no other pathology apparent. These were considered congenital synostoses.

Spondylitis of the ankylosing type has been discussed under various titles, such as spondylitis deformans, spondylose rhizomélique, spondylitis atrophica ligamentosa, Bechterew's, and Marie Strumpel's disease, each differing in such minor factors as to joints most involved, the presence of nerve-root irritation, muscle weakness, meningitis, and the ultimate posture of fixation, all, however, having the major characteristics of bone atrophy, synovial proliferation, pannus formation, calcification of ligaments, and final fixation.

Ankylosis of sacro-iliac joints due to this type of disease was found in 19 pelves. The calcification, which because of its physical appearance has been likened to candle drip, was found most frequently at that part of the joint in the pelvic brim, extending through the anterior ligament to form a bridge of bone

about $1\frac{1}{2}$ inch thick spanning the joint line. In its earlier stages the process is seen extending from both sacrum and ilium toward a common center. Posterior to the joint there is no capsular ligament. Here the strong irregular fibrous bands anchoring ilium to sacrum are rarely calcified. The average age of these 19 individuals was 45.9 years.

In 6 subjects ankylosis was due to lesions of distinctly hypertrophic type irregular exostoses fusing or interlocking across the joint. These averaged 67 years of age. The almost universal appearance of joint lipping at about the fortieth year of life and its progress with age must be considered here. Since joint structures respond in similar manner to chronic irritation by different agents, it is impossible to estimate the relative importance of several associated factors in the production of given pathological changes. Practically all of the individuals that make up this material present at least the three factors of age, mechanical strain and focal infection each tending to produce circulatory changes with disturbance of calcium metabolism. The writer admits his present inability properly to evaluate the various factors of the problem.

In 67 skeletons the two types of pathology were co-existent in various degrees of severity. These subjects averaged 57.3 years of age and all showed general joint lipping. Some of the older individuals particularly showed smooth calcification of the anterior sacro-iliac ligament and marked hypertrophic exostoses of their lumbar vertebrae. The co-existence of

the two types of arthritis in so great a number of skeletons suggests that they are of similar or closely related etiology. This coincides with the beliefs of H. Warren Crowe, Reginald Burbank and others, who from their exhaustive researches attribute the different types of arthritis to *Streptococcus hemolyticus* and *viridans*, and *staphylococcus* infections. Though they differ as to which is which, both insist that the great majority of arthritides are due to the combined activity of these organisms and both present strong therapeutic evidence to substantiate their claims.

Of the four pelvises presenting obliteration of a sacro-iliac joint probably congenital the left side was involved in 3 in 1 the right. One was a white female 72 years old 2 were colored women, 36 and 33 years old respectively. The other was a negro male of 31 years. The preponderance of females in this very small group is much the reverse of the series as a whole. Only 2 of the 92 with arthritic ankylosis were of this sex.

Embryologically the ilium develops in the hind limb bud and approaches the axial skeleton making contact with the first, second and third sacral segments in the seventh week of fetal life to form the sacro-iliac joint. This articulation thus differs fundamentally from those formed in the usual manner by vacuolation of the skeletal blastema between areas of chondrification. Ordinarily it presents all the features of a typical joint: synovia, articular cartilages and ligaments, but the synovial cavity is relatively small, the cartilages are

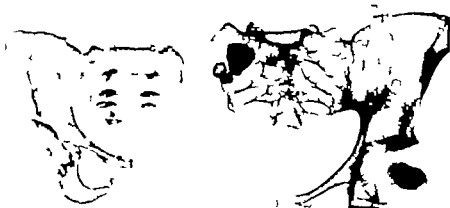


Fig. 1. Photograph and roentgenogram of congenital obliteration of a sacro-iliac joint.

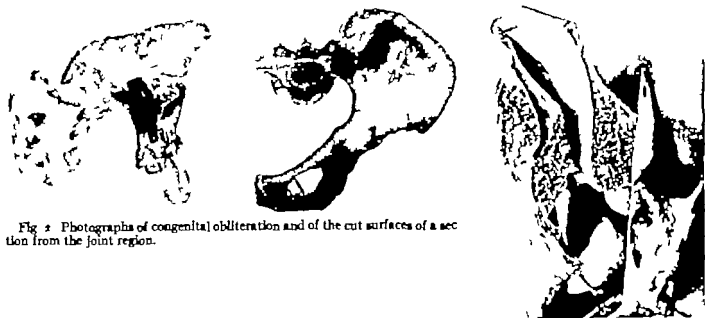


Fig. 2. Photographs of congenital obliteration and of the cut surfaces of a section from the joint region.

thin, their apposing surfaces irregular the ligament incomplete posteriorly, and mobility very slight. Considering these facts one is rather surprised at the incidence of only four synostoses in 1559 skeletons.

To determine the deeper structure of a synostosis and the possibility of its being only a superficial fusion, a section of bone was removed from the back of specimen 1750. This wedge cut through the joint area in two directions. The cut surface showed condensation of bone trabeculae in the area where the joint line should have been but no interruption of

bone architecture. If there had ever been a joint present all trace of its existence was lost. Shore has recorded similar findings in such an anomaly. Though others have written of sacro-iliac obliteration their descriptions are most suggestive of ankylosis.

The function of the hind limb is propulsive power. The first requirement of its articulation with the axial skeleton is stability. Since the assumption of the upright posture accentuates the need of stability we find that in man the sacro-iliac joint is relatively larger in all dimensions than in other animals, including

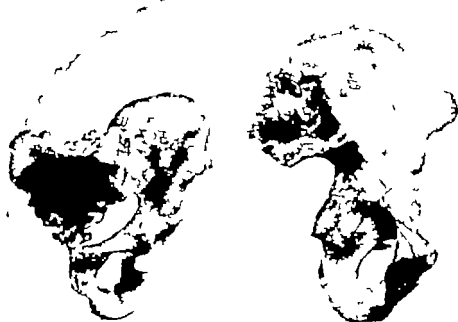


Fig. 3. The calcified structure has been broken, showing its thin superficial character.

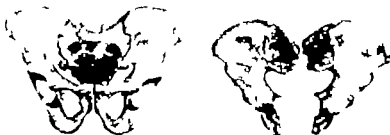


Fig. 4. With and without the sacrum. Smooth calcification of the right, irregular hypertrophy of the left sacro-iliac



Fig. 5. left. Smooth superficial calcification of the left sacro-iliac, complete except at the brim. This reverses the usual distribution of hypertrophic type. Fig. 6. Irregular lip



Fig. 7. Roentgenogram and photograph, contrasting evidence shown by transmitted and reflected light

more segments of the sacrum and presenting greater surfaces for attachment of ligaments (see Straus). Ankylosis is nature's method of stabilizing an insecure joint.

Though a clinical discussion of sacro-iliac arthritis will be endeavored in a later paper it is perhaps permissible here to compare the evidence of ankylosis as shown by X-ray and

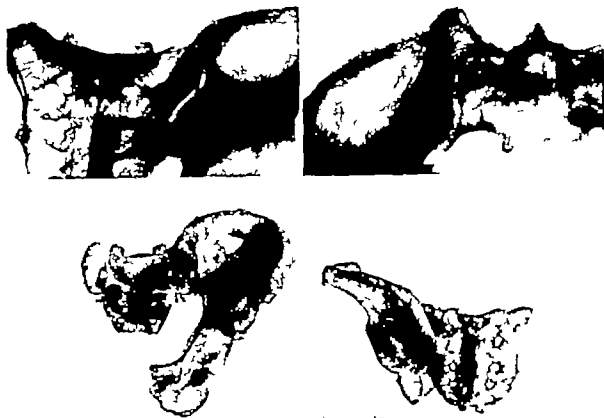


Fig. 8. Posterior ankylosis without narrowing of the joint line. Calcification of the posterior sacro-iliac ligament is exceptional. It is demonstrated by dorsovertical roentgenogram.



Fig. 9. Note the difference in X ray and photographic evidence of calcification and ankylosis. The sacrum is fixed by fusion of the last lumbar vertebra with both ilia.

photograph. Such a comparison compels one to the opinion that the points of importance in interpreting the ordinary X ray film are not the presence or absence of lipping at the upper and lower poles of the joint. These are the sites least affected. Neither is narrowing of the joint line dependable. There may be complete ankylosis without loss of cartilage thickness. The features of most significance are change in bone density and loss of clarity of

joint outline particularly at the pelvic brim. When actual lipping or calcification has occurred (and of course, arthritis has existed for some time by then) ventro- or dorso-vertical X ray views may be required to demonstrate it. The former is used by obstetricians in roentgenographic pelvimetry, the latter, to demonstrate abnormalities of the sacral canal.

The material from which this study was made comprised 1559 skeletons 392 of which

TABLE L.—A DETAILED CHART OF 96 SPECIMENS OF SACRO-ILIAC ANKYLOSIS FOUND IN 1539 SKELETONS

| Type | Cat. No. | Color | Sex | Age | Ride | | | Site | | | | Lipping | |
|------------------------------------|----------|-------|-----|--------|-------|------|------|-------|------|-------|-------|---------|------|
| | | | | | Right | Left | Back | Front | Back | Upper | Lower | Asial | Acet |
| (Congenital) | 966 | N | F | 25 | | L | | | | | | + | + |
| | 790 | W | F | 7 | | L | | | | | | + | + |
| | 1871 | M | F | 20 | R | | | | | | | | |
| | 876 | N | M | 5 | | L | | | | | | | |
| Total | 4 | 3 | 1 | A 43 | | 3 | | | | | | | |
| Spondylitic | 452 | M | M | 30 | | | B | + | | + | | | + |
| | 473 | N | M | 20 | | L | | | | + | | + | + |
| | 7 | M | M | 20 | R | | | | | | | | |
| | 377 | W | M | 27 | R | | | + | | | + | | |
| | 509 | W | M | 23 | R | | | + | | | | | |
| | 602 | W | M | 23 | | L | | + | | + | + | + | + |
| | 430 | W | M | 40 | | L | | + | | + | | | |
| | 1560 | W | M | 43 | | | B | + | | | | | |
| | 137 | W | M | 40 | | L | | | | + | | + | |
| | 676 | W | M | 44 | | L | B | + | | + | | | + |
| | 483 | W | M | 50 | R | | | + | | | | + | + |
| | 104 | W | M | 50 | | L | | + | | + | | + | + |
| | 1,064 | W | M | 53 | | | B | + | + | + | + | + | + |
| | 673 | W | M | 57 | R | | | + | | | | + | + |
| | 674 | W | M | 20 | | | B | + | | | | | + |
| | 900 | W | M | 62 | | | B | + | | + | | + | + |
| | 990 | W | M | 65 | R | | | + | + | + | + | + | + |
| | 20 | W | M | 72 | | L | | + | | | | + | + |
| | 903 | M | F | 73 | | L | | + | | | | | |
| Total | 9 | 5 | 4 | A 45.9 | 6 | 7 | 6 | 10 | | 9 | 4 | 10 | |
| Hypertrophic | 1045 | W | M | 40 | | | B | | | | | + | |
| | 130 | W | M | 66 | R | | | | + | | + | + | + |
| | 1726 | W | M | 70 | | | B | + | | + | + | + | + |
| | 10 | W | M | 71 | R | | | + | | + | | + | + |
| | 309 | N | M | 70 | R | | | + | + | | | + | + |
| Total | 115 | W | M | 75 | | | B | + | + | + | + | + | + |
| | 6 | 5 | 6 | A 67.1 | 3 | | 3 | 4 | 3 | 3 | 3 | 6 | 6 |
| Mixed spondylitic and hypertrophic | 1666 | M | M | 43 | R | | | + | | + | | | + |
| | 198 | N | M | 48 | | | B | + | | + | | + | + |
| | 46 | N | M | 48 | | | B | + | | + | | + | + |
| | 470 | N | M | 5 | R | | | + | | | | + | + |
| | 277 | N | M | 25 | | | B | + | | + | | + | + |
| | 1200 | N | M | 65 | | | B | + | + | | | + | + |
| | 526 | N | M | 67 | | | B | + | | + | | + | + |
| | 1663 | N | M | 80 | | | B | + | | + | | + | + |
| | 1320 | N | M | 83 | | | B | + | | + | | + | + |
| | 1877 | N | M | 81 | | | B | + | | + | | + | + |

TABLE I.—A DETAILED CHART OF 96 SPECIMENS OF SACRO-ILIAC ANKYLOSIS FOUND IN 1559 SKELETONS—Continued

| Type | Crad. No. | Color | Sex | Age | Side | | | Site | | | | L— | |
|------|-----------|-------|-----|-----|-------|------|------|-------|------|-------|-------|------|-------|
| | | | | | Right | Left | Both | Front | Back | Upper | Lower | Ant. | Post. |
| | 1433 | W | F | 8 | | | B | + | + | | + | — | — |
| | 1501 | W | M | 45 | R | | | + | | + | — | — | — |
| | 444 | W | M | 45 | | | B | | | + | — | — | — |
| | 885 | W | M | 45 | | L | | + | | + | — | — | — |
| | 1007 | W | M | 45 | | | B | + | | + | — | — | — |
| | 1118 | W | M | 45 | | L | | | + | | — | — | — |
| | 666 | W | M | 47 | | | B | + | | + | — | — | — |
| | 00 | W | M | 40 | R | | | + | | + | — | — | — |
| | 643 | W | M | 50 | | | B | + | | + | — | — | — |
| | 181 | W | M | 50 | R | | | | | + | — | — | — |
| | 200 | W | M | 50 | | L | | | | + | — | — | — |
| | 230 | W | M | 50 | | L | | + | | + | — | — | — |
| | 509 | W | M | 5 | | | B | + | | + | — | — | — |
| | 18 | W | M | 51 | R | | | | | + | — | — | — |
| | 87 | W | M | 51 | | | B | + | | + | — | — | — |
| | 1670 | W | M | 53 | | L | | + | | + | — | — | — |
| | 500 | W | M | 53 | R | | | + | | + | — | — | — |
| | 155 | W | M | 50 | | | B | + | | + | — | — | — |
| | 780 | W | M | 54 | R | | | + | | | — | — | — |
| | 418 | W | M | 54 | R | | | + | | | — | — | — |
| | 1438 | W | M | 54 | R | | | + | | + | — | — | — |
| | 1556 | W | M | 54 | | | B | + | | | — | — | — |
| | 1503 | W | M | 55 | | | B | + | | + | — | — | — |
| | 650 | W | M | 55 | | | B | + | | | — | — | — |
| | 176 | W | M | 55 | | L | | + | + | | — | — | — |
| | 107 | W | M | 57 | | L | | + | | | — | — | — |
| | 1010 | W | M | 58 | | L | | + | | | — | — | — |
| | 1636 | W | M | 58 | | | B | + | | | — | — | — |
| | 663 | W | M | 60 | | L | | + | | + | — | — | — |
| | 161 | W | M | 60 | | L | | + | | + | — | — | — |
| | 198 | W | M | 60 | | L | | + | | + | — | — | — |
| | 881 | W | M | 60 | R | | | + | | | — | — | — |
| | 9 | W | M | 60 | | | B | + | | | — | — | — |
| | 167 | W | M | 60 | | | B | + | + | + | — | — | — |
| | 660 | W | M | 64 | | L | | + | | | — | — | — |
| | 340 | W | M | 63 | | L | | + | + | | — | — | — |
| | 363 | W | M | 64 | | L | | + | | | — | — | — |
| | 113 | W | M | 65 | | | B | + | | + | — | — | — |
| | 1118 | W | M | 65 | R | | | + | | | — | — | — |
| | 1640 | W | M | 67 | | | B | + | + | + | — | — | — |
| | 309 | W | M | 66 | | L | | + | | + | — | — | — |
| | 1780 | W | M | 66 | | | B | + | | + | — | — | — |

Mild spotty
ilic and
hypertrophic

TABLE I.—A DETAILED CHART OF 96 SPECIMENS OF SACRO-ILIAC ANKYLOSIS FOUND IN 1559 SKELETONS—Continued

| Type | Cad No | Color | Sex | Age | Side | | Site | | | | Lipping | | |
|--|--------|-------|-----|------|-------|------|------|-------|------|-------|---------|-------|-------|
| | | | | | Right | Left | Back | Front | Back | Upper | Lower | Axial | Acet. |
| Mixed spondylo- arthritis and hypertropi | 353 | W | M | 68 | | | R | + | | + | | + | + |
| | 303 | W | M | 60 | R | | | + | | | | + | + |
| | 304 | W | M | 70 | | | R | + | | + | | + | + |
| | 304 | W | M | 70 | R | | | + | | + | | + | + |
| | 1490 | W | M | 7 | | | R | + | | + | | + | + |
| | 30 | W | M | 7 | R | | | + | | | | + | + |
| | 680 | W | M | 77 | | | R | + | | | | + | + |
| | 1017 | W | M | 77 | | | R | + | | + | | + | + |
| | 178 | W | M | 79 | | | R | + | | + | | + | + |
| | 326 | W | M | 79 | | | R | + | | + | | + | + |
| | 977 | W | M | 8 | | | R | + | | + | | + | + |
| | 3 | W | M | 88 | R | | | + | | + | | + | + |
| | 8 | W | M | 79 | | L | | | | + | | + | + |
| | 300 | W | M | 40 | | | R | | | + | | + | + |
| | 1433 | W | M | 45 | | L | | + | | + | | + | + |
| Total | 67 | 66 | 66 | A 77 | 6 | | 14 | 50 | | 47 | 6 | 66 | 67 |

TABLE II.—SYNOPSIS WITH MODES AND AVERAGES OF TABLE I

| Type | No | Color W - H | Sex M - F | Average Age | Side | | | Site | | | | Lipping | |
|--------------|----|----------------|--------------|----------------|-------|------|------|-------|------|-------|-------|---------|------|
| | | | | | Right | Left | Both | Front | Back | Upper | Lower | Antal | Acet |
| Congenital | | 3 | | 43 | | 3 | | | | | | | |
| Spondyloitic | 0 | 8 | 8 | 45.9 | 6 | 7 | 6 | 16 | | 9 | 4 | 10 | |
| Hypertrophic | 6 | 8 | 6 | 67 | 3 | | 3 | 4 | 3 | 3 | 3 | 6 | 6 |
| Mixed | 67 | 58 | 66 | 57 | 6 | 7 | 14 | 50 | 7 | 43 | 6 | 66 | 66 |
| Totals | 96 | 77 | 79 | 57 | 16 | 17 | 43 | 79 | 16 | 64 | 7 | 84 | 86 |

were of colored males, 105 colored females, 125 white females and 936 white males. It appears then that the incidence of sacro-iliac ankylosis is proportionately nearly twice as great in the negro as in the white subjects and practically three times as frequent in the male as the female. There is no preference as to right and left side. It is nearly as often bilateral as unilateral. That part of the joint which takes part in the formation of the pelvic brim is by far the most frequently involved. The process extends from the brim upward much more than downward and seldom involves the lower pole of the joint. In other words the bone and joint changes are in direct ratio to mechanical stresses of upright posture.

In individuals more than 40 years old lip-ping of the axial skeleton and acetabulum is practically universal and increases with age.

CONCLUSIONS

1. From the standpoint of skeletal change the sacro-iliac joint is more frequently and more extensively involved in arthritic lesions than any other joint of the body.

2. Two distinct usually co-existent types of arthritis affect the sacro-iliac joint.

3. Because of its manner of development the sacro-iliac is subject to embryonic defect and thus shows congenital obliteration more frequently than other joints.

4. Since the joint retains in man the ana-

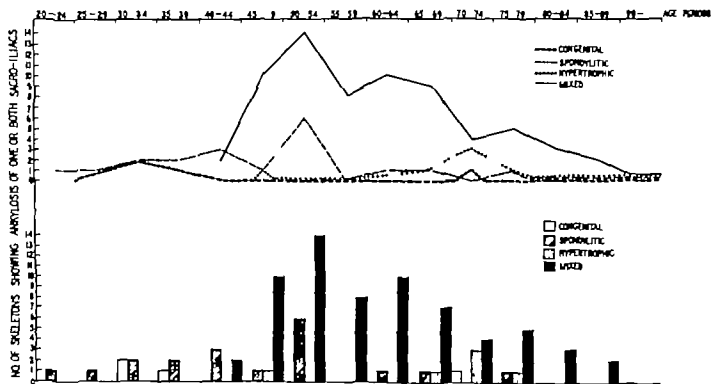


Fig. 10. Chart showing incidence of the different types of sacro-iliac ankylosis in relation to age factor

tomical features of its quadrupedal origin the mechanical stresses peculiar to the upright posture subject it to ligamentous strains. Ankylosis is a compensatory mechanism for stabilization.

5. Current roentgenographic criteria for determination of sacro-iliac joint defect are in urgent need of revision.

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INFRAPULMONARY EMPYEMA¹

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INFRAPULMONARY (diaphragmatic, supradiaphragmatic) empyema is a type of encapsulated suppurative pleuritis in which the effusion is interposed between the lower lobe of the lung and the diaphragm. Its difficulty of recognition, the fact that often it is undiagnosed until the late stages, the frequency with which it may be confused with certain pulmonary and extrapulmonary conditions, and finally the technical problems which may arise at the time of operation, all contribute not only to its general interest but also to its importance.

In spite of its many interesting features apparently only scant attention has been paid to the subject in the past and a search of the recent literature has failed to disclose a single reference to the subject by title. While the lesion is well known and has been described in textbooks (5) and reported in articles dealing with encapsulated empyema (10) it generally has been regarded merely as an unusual variety of the latter, diagnosable as a rule only by X-ray examination or occasionally unexpectedly encountered at postmortem section. Under these circumstances it is not surprising that comparatively little has been written concerning its clinical, diagnostic, or therapeutic aspects. In our experience, the lesion while not common has been by no means as rare as generally assumed and of late has come to be pre-operatively recognizable with increasing frequency.

This communication is based on observations made in a series of 12 cases² from the Surgical Service of Dr. Harold Neuhof at the Mt. Sinai Hospital, New York. Four additional cases were encountered in a search of the general files of the hospital. Inasmuch as the latter were not observed personally by the author they have been utilized only to the extent of recording the type of organism present and the nature of the underlying causative pulmonary process. In this paper

we will confine ourselves to a discussion of the practical aspects of the subject based on the study of our material. Since a statistical review of such a small series is apt to be inconclusive figures for the most part have been eliminated.

DEFINITION

Intrapulmonary empyema is a term originated by Wenker to designate an encapsulated collection of pus situated between the under surface of the lower lobe of the lung and the diaphragm. The term 'intrapulmonary' rather than diaphragmatic or supradiaphragmatic empyema is employed because it most accurately describes the lesion. For example, an encapsulated empyema situated in the lowermost part of the general pleural cavity may extend downward into the costophrenic sinus and make contact with the periphery of the diaphragm. This may be broadly classified by some as a supradiaphragmatic empyema, but the use of the more precise term intrapulmonary empyema immediately eliminates it from our consideration.

ETIOLOGY

1. As in other varieties of pleural suppuration intrapulmonary empyema most commonly is the result of extension of infection from the lung into the adjacent pleura. In this connection it should be stated that it may exist as the sole pleural lesion or as a secondary part of a more widespread pleural suppurative process.

2. A second cause is the extension of infection from beneath the diaphragm as in subphrenic or liver abscess.

This discussion is specifically limited to the group in which the intrapulmonary empyema is derived from infection in the lung and represents the sole pleural lesion. All of the cases in this series fall precisely into the above group.

BACTERIOLOGY

As is the case in other varieties of pleural suppuration, no specific type of organism is

¹ Since submitting the manuscript for publication, 2 additional cases of intrapulmonary empyema have been observed by the author.

² From the Surgical Service of Dr. Harold Neuhof, Mt. Sinai Hospital, New York.

Delivered before the Surgical Section of the New York Academy of Medicine, May 2, 1935.

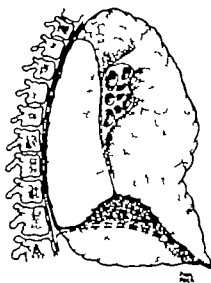


Fig. A.

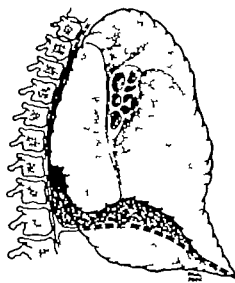


Fig. B

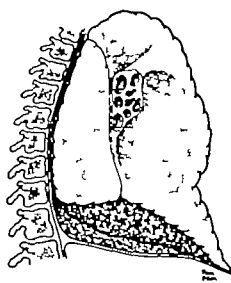


Fig. C

Fig. A. Mediastinal aspect of the left lung. Group 1 lesion. Diaphragm indicated by broken lines. Collection of pus situated between dome of diaphragm and under surface of lung. Note that empyema is separated from the chest wall anteriorly, laterally and posteriorly by the lappet of lower lobe which dips into the costophrenic sinus.

Fig. B. Mediastinal aspect of left lung. Group 2 lesion. Diaphragm indicated by broken lines. Collection of pus between dome of diaphragm and under surface of lung extends posteriorly, and there comes into contact with the chest wall after elevating the posterior margin of the lung. Collection then enlarges chiefly in the region behind rather than beneath the lower lobe. Note that empyema is

separated from the chest wall only on the anterior and lateral aspects by the lappet of lower lobe which dips into the costophrenic sinus.

Fig. C. Mediastinal aspect of left lung. Group 3 lesion. Diaphragm indicated by solid lines. Collection of pus between dome of diaphragm and under surface of lung extends laterally and posteriorly and comes into contact with the chest wall after elevating the lateral and posterior margins of the lung. Collection remains loculated beneath the lower lobe, however, and does not extend into general pleural cavity as in Group 2. Note that the lappet of lower lobe anteriorly still remains adherent in the costophrenic sinus.

responsible for infrapulmonary empyema and the organism present varies according to the type existing in the underlying pulmonary source of infection. The following types of bacteria in their order of frequency, were noted pneumococcus 9 cases, mixed anaerobes, 3 cases (3) Staphylococcus aureus, 1 case, and negative smear and sterile culture, 3 cases.

PATHOLOGY AND PATHOGENESIS

The essential pathological feature is the existence of an infective lesion involving the basilar portion of the lower lobe, with the subsequent development of a suppurative process in the subjacent pleural space between the under surface of the lower lobe and the diaphragm. The following pulmonary lesions, in the order of their frequency, have been noted in this series: lobar or bronchopneumonia, 12 cases, ruptured putrid lung abscess 3 cases and necrosis of an infected pulmonary infarct, 1 case.

For purposes of description and classification the cases have been divided into three groups.

1. The first group is comprised of cases in which the purulent collection remains localized between the lower lobe and the diaphragm, and does not come into contact with the chest wall at any point. In the early stage the lesion is small, and the portions of the under surface of the lobe peripheral to it become adherent to the surface of the diaphragm as a result of the existing inflammatory reaction. The purulent collection thus becomes encapsulated and completely separated from the chest wall on all aspects. As the empyema enlarges, it gradually peels more and more of the under surface of the lobe away from the diaphragm until finally the two are separated over a comparatively wide area. At the extreme periphery, however, the margin or lappet of the lower lobe remains firmly adherent to the diaphragm in the region of the costophrenic sinus. Although this por-

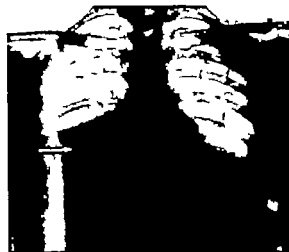


Fig. 1 D Case Intrapulmonary empyema Early stage. F1 reveals only consolidation (indicated by arrow) of the right lower lobe, diagnosed as pneumonia. Small empyema beneath the lower lobe is obscured by the pulmonary traction Group lesion.

tion of the lung may eventually become considerably thinned out and compressed between the tense collection of pus and the chest wall; it nevertheless remains interposed between the two (Fig. A).

2. The second group is comprised of cases in which the purulent collection after reaching a variable size dissects its way beneath the margin of the lower lobe at a certain point and there comes into contact with the chest wall. This can occur only in an area in which the margin has failed to become or remain firmly adherent to the diaphragm. The usual site of such failure is posteriorly, most commonly in region close to vertebral column.

The reason for this phenomenon seemingly is based on the anatomical configuration of the base of the lower lobe and its relationship to the adjacent chest wall and diaphragm. The margin (free edge, lappet) of the lower lobe which separates the thoracic and the diaphragmatic surfaces is for the most part sharp and elongated and dips deeply into the costophrenic sinus on the anterior, lateral and posterior aspects of the chest. In the region close to the vertebral column, however, the margin merges with the broad vertical posterior border of the lung and here is blunt and rounded. In this area also the costophrenic



Fig. 2 L D Intrapulmonary empyema Dense shadow with convex upper border in lower half of right chest. Moderate cardiac displacement. Lesion indistinguishable from elevated diaphragm. Group 3 lesion.

sinus is very shallow. In the presence of an inflammatory reaction beneath the lower lobe, agglutination of the lung margin to the diaphragm in the already mentioned region is often imperfect, because of the smaller and less intimate area of contact between the lung and the structures which constitute the costophrenic sinus. The result is that the enlarging intrapulmonary collection more readily elevates the margin of the lung at this point and comes into contact with the chest wall. It thus as we say acquires a parietal representation.

In the later stages, the enlargement of the empyema takes place as a rule chiefly in the parietal portion, i. e. the part that lies within the general pleural cavity. The end stage of this variety then discloses the existence of an intrapulmonary collection with a parietal extension of varying size and shape situated usually posteriorly. In some cases the parietal extension remains confined to the lower part of the chest while in others it rapidly enlarges in all directions and finally may reach such size as to overshadow completely the original intrapulmonary portion (Fig. B).



Fig. 3 M.B. Intrapulmonary empyema. Dense shadow with convex upper border occupying major portion of right chest. Base of lung elevated to an extreme degree. Lesion indistinguishable from elevated diaphragm (more advanced lesion than in Fig. 2). Note cardiac displacement. Group 3 lesion.



Fig. 4. M.B. Same patient as in Figure 3 several days after operation. Upper arrow indicates base of lower lobe which is still elevated. Lower arrow indicates drained intrapulmonary empyema cavity between base of lower lobe and diaphragm. Note that cardiac displacement is still present.

3 The third group is comprised of cases in which the characteristics of the first and second are combined. The entire effusion remains loculated beneath the lower lobe but at the same time it is not separated from the chest wall by the margin of the lung. The latter itself becomes elevated due to inadequate primary adhesion formation or to the dissolution of existing adhesions. The result is that the entire under surface of the lobe including the margin becomes widely separated from the diaphragm. The collection of pus, therefore, makes contact with the chest wall over a horizontal band like area between the diaphragm and the margin of the elevated lower lobe. This band like zone of parietal representation exists usually over the posterior and posterolateral aspects of the chest since the anterior portion of the lappet as a rule remains adherent in the costophrenic sinus and therefore does not become elevated (Fig. C).

These in general are the three groups into which the cases fall but it is to be remembered that the actual extent of the lesion found in each case at operation, will depend on the

stage in which the patient is operated upon and the adequacy of the limiting adhesions which tend to keep the process localized.

SYMPTOMATOLOGY

The general symptomatology of intrapulmonary empyema does not differ greatly from that of other varieties of encapsulated empyema. The pleural infection may make itself manifest either during the active course of the pulmonary disease (sympneumonic), or after the pulmonary process has begun to subside (postpneumonic). In the former case the onset of the pleural infection is apt to be insidious whereas in the latter case it is usually marked by a recrudescence of such symptoms as cough fever malaise etc.

The symptomatology peculiar to the disease consists in the existence of early pain due to diaphragmatic irritation. As Capps has demonstrated the site of pain is dependent on the area of diaphragmatic involvement i.e. central or peripheral, or both. Irritation of the central portion or dome results in pain in the shoulder over the area supplied by the third fourth, and fifth cervical nerves. This

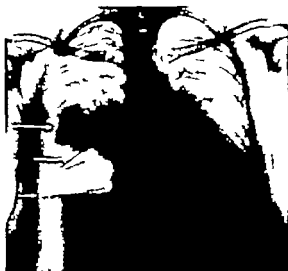


Fig. 5. F.M. Case. Intrapulmonary pyopneumothorax. Base of lower lobe (indicated by upper arrow) elevated to a marked degree by a subjacent collection of pus and air. Compressed base of lower lobe at first glance appears to be the diaphragm. (Diaphragm actually lies at a lower level and is obscured by the fluid. [Indicated by the lower arrow.]) Note faint frog markings and pulmonary fissure indicated by center arrow) situated above fluid level, proving that diaphragm lies lower down. Note cardiac displacement. Cardiac enlargement is due to chronic valvular disease. Group 3 lesion.

phenomenon is due to reflex stimulation by way of the phrenic nerve which takes origin from the same roots. Irritation of the pe-



Fig. 7. J.W. Intrapulmonary effusion, left chest. Film taken after induction of pneumoperitoneum to differentiate lesion from a subphrenic abscess. Note air (indicated by arrow on right side and lower arrow on left side) between diaphragm and dome of liver. Effusion (indicated by upper arrow on left side) is present above left diaphragm. Group 1 lesion.



Fig. 6. F.M. Same patient as in Figure 5. 6 months after operation. Note expansion of lung and return of enlarged heart to normal position as indicated by location of its right border. Residual thickening of pleura (indicated by arrow) still present. Case.

ripheral portion of the diaphragm results in pain in the lower chest, upper abdomen, and occasionally even in the lower abdomen. In this connection Kelly and Weiss have stressed the frequency of pain along the entire costal arch especially posteriorly beneath the twelfth rib. Characteristic pain if present is most apt to exist early in the course before the stage of frank effusion has been reached. As the effusion develops the irritated pleural surfaces become separated by fluid and pain is apt to become less and often disappears. Since patients are frequently seen late in the course of the infection when pain is absent, the history and site of previous pain may be of great importance.

It is to be remembered that pain of diaphragmatic origin may also be noted in the presence of irritative lesions situated beneath as well as above the diaphragm. It therefore, is in no sense pathognomonic of intrapulmonary empyema but rather is to be considered only strongly suggestive, when supported by other findings which will be mentioned later.

PHYSICAL SIGNS

As stated before an intrapulmonary empyema does not come in contact with the chest

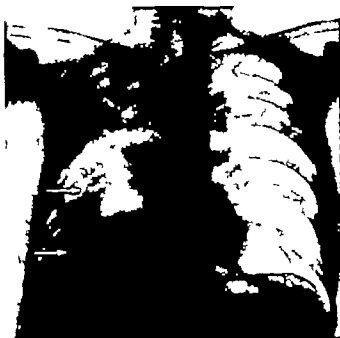


Fig. 8 C.S. Case 4. Intrapulmonary empyema, right chest. Lesion (indistinguishable from elevated diaphragm) is indicated by lower arrow. Moderate sized parietal extension (indicated by upper arrow) extends upward to sixth interspace posteriorly. Note dense infiltration of upper lobe and medial portion of lower lobe. Note evidence of atelectasis of upper lobe. Group 2 lesion.



Fig. 9 C.S. Same patient as in Figure 8 2 months after operation. Note complete expansion of lung and normal appearance of diaphragm. Evidence of chronic hilar tuberculosis present.

wall, when it is completely overlaid on its periphery by the lappet of lower lobe which is adherent to the peripheral portions of the diaphragm (Group 1 under "Pathology and Pathogenesis"). When the lesion is small the characteristic physical signs of fluid at the base may therefore be absent and the only signs elicited may be those of the co-existent infiltration in the overlying lung tissue. The percussion note varies from slight dullness to flatness, depending on the size of the purulent effusion. Voice and breath sounds likewise may vary from slight diminution to complete absence. In addition in the presence of a large effusion evidence of compression of the base of the lung is present and physical signs of diminished or absent diaphragmatic mobility are usually elicited. Regardless of the nature of the other physical signs, the presence of dullness or flatness at the extreme base should make one suspect the presence of an intrapulmonary empyema, if the patient's clinical course suggests the existence of a suppurative lesion the site of which is not apparent. This point cannot be too strongly emphasized if early diagnosis is to be made. If, in

addition trapezius tenderness is present the diagnosis is more likely.

2. After the collection of pus has extended to the chest wall and acquired a parietal representation (Groups 2 and 3 under "Pathology and Pathogenesis") the physical signs vary according to the size and shape of the latter. If small, the physical findings do not necessarily become altered, and the only change noted may be the development of localized tenderness to pressure over a small area in the lowermost part of the chest usually close to the vertebral column. This is due to irritation of the underlying pleura as a result of extension of the process to the parietes. As the parietal portion of the collection becomes larger the signs of an encapsulated empyema in the posterior part of the chest become apparent and often obscure those due to the original intrapulmonary portion.

An intrapulmonary effusion even of moderate size, because of its close proximity to the border of the heart, frequently tends to displace that organ for a variable distance toward the opposite side of the chest. This is particularly true, because of the limited amount of space available for expansion, when the lesion is situated on the left side.

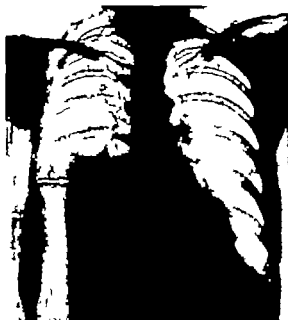


Fig. 10. R.S. Case 7. Intrapulmonary empyema with large parietal extension. Well defined encapsulated empyema of lower lobe (indicated by arrow) is present in lower part of general pleural cavity and extends upward to level of seventh rib posteriorly. Intrapulmonary portion of lesion is completely obscured. Note cardiac displacement. Group 2 lesion.

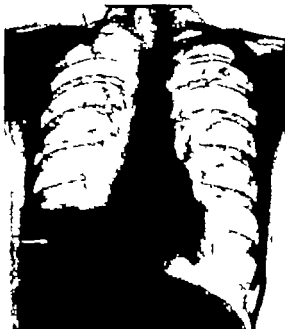


Fig. 11. R.S. Same patient as in Figure 10, 1 week after operation. Note rapid expansion of lung. Small residual drained cavity (poorly reproduced on film) (indicated by arrow). Residual pleural thickening at base is also still present. Heart has returned to normal position.

The phenomenon while not constant occurred with sufficient frequency to attract attention. The four most common causes of cardiac displacement resulting from pleural suppuration are large pleural effusion, tension pyopneumothorax, encapsulation along the mediastinal aspect of the pleura and parietally situated encapsulation in the lower part of the chest. As a rule these gross lesions can be readily diagnosed on careful physical examination. In the absence of evidence of their existence cardiac displacement when associated with dullness or flatness at the extreme base should suggest the diagnosis of intrapulmonary empyema if the history and clinical course suggest pleural suppuration. In passing it should be stated that elevation of the diaphragm due to subphrenic or liver abscess, may also at times cause cardiac displacement.

X. RAY EXAMINATION

X-ray examination reveals in general the following groups of findings:

1. When the lesion is small and separated from the chest wall on all aspects by the margin of lower lobe the shadow cast by the effusion is particularly apt to merge with and be indistinguishable from the shadow cast by the overlying infiltrated pulmonary tissue. In cases of this type the most common and in fact the only interpretation that can be made is that of basilar pneumonia (Fig. 1).

2. Larger localized intrapulmonary collections usually elevate and arch the base of the lung to a varying degree. As a rule one then sees on the film a dense shadow with a sharply defined convex upper border extending across the lower portion of the lung field. This shadow merges below with that of the liver. Because of this fact the impression may be gained that the picture is one of an elevated diaphragm due to a subphrenic abscess, especially when on fluoroscopy there is noted immobility in the general region of the diaphragm (Figs. 2 and 3). However the lack of history and physical signs of an intra-abdominal inflammatory lesion which could

be considered responsible for a subphrenic abscess militates against this interpretation

3 When the lesion has extended from beneath the lower lobe to the chest wall and then further enlarged in the parietal portion (i.e., the part which lies within the general pleural cavity) the latter rather than the original intrapulmonary portion is often apt to be noted on X ray examination (Fig 10). The reason is that the shadow cast by the intrapulmonary portion may become obscured by the shadow of the larger parietal portion. Parietal extensions as stated before take place generally in a posterior direction and usually cast readily discernible shadows when films are taken in the antero-posterior erect position. If the parietal portion is small, however, it may be obscured by the superimposed shadow of the intrapulmonary portion or the infiltrated lower lobe. Additional films should, therefore, always be taken with the patient in the lateral erect position in order to demonstrate these small lesions which lie most commonly in the posterior part of the chest close to the vertebral column.

4. Intrapulmonary pyopneumothorax produces as a rule a characteristic picture (Fig 5). Extending across the lower part of the lung field one sees a dense, arched, band like, transverse shadow with a subjacent collection of air surmounting a fluid level. The band like shadow which at first glance appears to be the diaphragm, represents a portion of the base of the lung which has been elevated and compressed like an accordion, by the collection of air and pus below. The diaphragm is situated at a lower level and is usually obscured by the fluid.

In these cases, the diagnosis of subdiaphragmatic gas-containing abscess may erroneously be made. One feature, however, militates against this interpretation. This is the presence of faint lung markings which are usually seen below the previously mentioned band like structure that represents not the diaphragm but the elevated portion of the base of the lower lobe. These markings represent the shadows cast by the anterior portion of the lappet of the lower lobe which as previously stated usually becomes adherent in the costophrenic sinus. Another fact that

militates against the diagnosis of subphrenic gas-containing abscess, is the lack of history and physical signs suggesting the presence of an intra abdominal inflammatory lesion or a perforation of the gastro-intestinal tract.

Although not usually necessary the induction of a small pneumoperitoneum may be of value in cases in which doubt exists as to whether the process is situated above or below the diaphragm. Air when introduced into the peritoneal cavity of a normal person in the erect position, tends to rise and usually collects beneath the diaphragm which it sharply delineates from the dome of the liver below. If the procedure is carried out in a patient with an intrapulmonary empyema or pyopneumothorax the air likewise collects beneath the diaphragm and delineates the shadow due to the purulent collection and the subjacent diaphragm from the shadow of the liver below (Fig 7). On the other hand in a patient with a subphrenic abscess, if a pneumoperitoneum is induced no air enters the space between the diaphragm and the dome of the liver, and the shadows of these structures appear merged. The air then collects below the liver, or in the opposite uninvolved subphrenic space, or both. Differential diagnosis is thus made possible.

Cardiac displacement, which is the final point to be considered under X ray diagnosis is of the greatest significance when present in those cases in which the films disclose only infiltration in the lower lobe. The infiltration as stated before is usually interpreted as being due to pneumonia. However, since uncomplicated pneumonia is not a cause of cardiac displacement toward the opposite chest and the gross pleural lesions previously enumerated to account for the shifting of the heart are not discernible, the presence of an obscured effusion encapsulated beneath the lower lobe should always be strongly considered (Fig 1). The importance of this point cannot be over emphasized.

When the intrapulmonary effusion is obvious on X ray examination or when parietal extensions are present, cardiac displacement is of interest but of considerably less significance from a diagnostic viewpoint (Figs 3, 5, and 10).

From the foregoing statements it is evident that correct roentgenographic diagnosis is sometimes difficult or even impossible, especially in the cases in which small or moderate-sized intrapulmonary collections with or without parietal extensions exist. Further procedures are, therefore, sometimes necessary to establish the diagnosis. In this connection the rôle of aspiration of the chest is an important one.

CHEST ASPIRATION

1. Let us consider first the small intrapulmonary collection completely separated from the chest wall by the lappet of lower lobe which is adherent to the peripheral portions of the diaphragm. With this type of lesion when the aspirating needle is introduced into the chest pus is not immediately encountered. In order to enter the purulent collection the needle must be passed through the pulmonary tissue which lies between the chest wall and the empyema cavity. Thus the true nature of the lesion will not be early established by aspiration, even though the physical signs and roentgenographic examination strongly suggest the presence of fluid unless one is fully aware of the necessity of aspirating the chest deeply.

When a small collection increases in size the overlying shell of lung interposed between it and the chest wall becomes increasingly thin and more compressed. The aspirating needle then usually encounters pus at a depth only slightly greater than the thickness of the chest wall. Obviously therefore, the depth to which the needle must be introduced in any given case depends on the thickness of the overlying shell of compressed lung. This in turn depends on the size of the tense encapsulated collection of pus, i.e., the larger the empyema, the thinner will be the overlying shell of lung.

The site of aspiration as a rule is in the ninth or tenth interspace over the posterolateral aspect of the chest, and is best indicated by the height of the basilar shadow on X-ray examination. Attention is called to the possibility of penetrating the diaphragm, by aspiration at too low a level. We have seen this occur in one case fortunately without untoward effect.

2. When the original intrapulmonary empyema makes contact with the chest wall and a parietal extension develops in the general pleural cavity as demonstrated by X-ray examination, pus will be encountered as soon as the needle enters the chest provided the aspiration is performed at the proper site. This point is best indicated by a study of the films taken in both the anteroposterior and lateral erect positions.

3. When the history and physical findings suggest the presence of intrapulmonary suppuration although X-ray examination reveals only infiltration in the lower lobe, aspiration should be deferred until such time as the presence and extent of the effusion become apparent on X-ray examination. On the other hand, immediate exploratory puncture may very occasionally be indicated because of the patient's progressively downhill course as the result of marked toxic absorption.

It should be emphasized that once pus has been encountered in the case of a collection loculated beneath the lower lobe the needle should not be withdrawn but should be left *in situ* and operation proceeded with as soon as possible. This is of prime importance, because the collection may be so small or difficult of access that, after the needle has been withdrawn, later attempts to locate it may fail. It follows, therefore, that aspiration should be performed only when operation can be proceeded with promptly.

DIAGNOSIS

The diagnosis of intrapulmonary empyema rests on a complete consideration of the history, physical signs, clinical course, X-ray examination and the result of aspiration of the chest.

As has been stated before the history is not characteristic and can at best only suggest the presence of suppuration within the chest. If pain of diaphragmatic origin exists, or formerly existed, the diagnosis is more likely. Depending on the size of the effusion, the physical signs of fluid at the base may be definite in some cases and equivocal in others. When the lesion is of fair size, X-ray examination usually reveals its presence, whether or not frank physical signs of fluid exist at the base. The

effusion may be clearly demonstrated to be situated beneath the lower lobe. At times, however, the induction of artificial pneumoperitoneum is necessary to distinguish it from a subphrenic or liver abscess. The latter is also usually excluded by the history and clinical course.

When frank physical signs of fluid at the base are not present, one usually elicits signs of consolidation in the lower lobe. In these cases, X ray examination usually reveals only infiltration which is interpreted as being due to pneumonia in the lower lobe. In other cases, even when the physical signs of fluid are definite, the X ray examination may reveal identical findings.

Regardless of whether the physical signs are interpreted as being due to consolidation or fluid at the base, a history and clinical course suggesting the existence of suppuration within the chest, the site of which is not apparent, should always arouse suspicion. Even an X ray examination which reveals only the presence of infiltration in the lower lobe, does not militate against the diagnosis. The co-existence or history of tenderness along the trapezius or over the lower chest posteriorly, lends support to the diagnosis. If in addition, cardiac displacement toward the opposite side of the chest without apparent cause is present, the diagnosis is practically certain.

In late cases X ray and physical examination may disclose a parietally situated empyema in the lower part of the general pleural cavity, which only at operation can be proved to be either a simple encapsulated collection or a parietal extension of an original intrapulmonary lesion.

Aspiration is merely confirmatory in those cases in which the effusion is demonstrated on X ray examination. When the X ray films are negative for fluid, however, it is truly an exploratory procedure which is sometimes necessary to confirm or disprove the presence of a suspected collection of pus beneath the lower lobe. The necessity for aspirating deeply in certain cases is again emphasized.

TREATMENT

1 In those instances in which the collection of pus has extended from beneath the

lower lobe to the chest wall and therefore has acquired a parietal representation (Groups 2 and 3 under "Pathology and Pathogenesis"), the plan of procedure is to excise a segment of overlying rib and to enter the cavity safely within the area of limiting adhesions. The rib is then further removed anteriorly and posteriorly, in order adequately to expose the pocket to its limits. If necessary, the intercostal musculature above and below the resected rib may be excised and segments of adjacent ribs removed, in order not only to afford an adequate view of the existing pathological process but also to facilitate drainage. Care must always be exercised to remain within the area of limiting adhesions and thus to avoid infecting the free pleural cavity. After all pus and detritus have been evacuated by suction, a sterile examining light is introduced and the interior of the cavity inspected.

Free exposure and direct inspection are of prime importance in all suspected cases of intrapulmonary empyema. As stated before, if a patient is first seen in the later stages of illness with a large parietal empyema, it is often impossible to determine whether one is dealing with the common variety of parietal empyema or a large parietal extension from an original intrapulmonary collection. If intercostal drainage or short rib resection without inspection of the interior of the cavity is performed, one is still unable to answer the question. Of more serious import is the danger of inadequate drainage of the primary pleural focus, which may result if an intrapulmonary pocket is present. Drainage is particularly apt to be poor in the cases in which the parietal and intrapulmonary pockets communicate by means of a narrow tract (see Case 8 of abstracts). Furthermore, in cases of putrid empyema due to infection by anaerobes complete unlocking of the suppurative focus with resultant free aeration is the only method which can be depended upon to lead to prompt subsidence of infection.

The next step in the procedure is to inspect the interior of the intrapulmonary pocket and to seek the site of entry of the pleural infection. This is of great importance, as failure to recognize and properly treat the underlying pulmonary lesion, especially in cases of rup-

tured putrid lung abscess, may result in chronicity of the lesion itself with or without later recurrence of the empyema even after the wound has healed. If the pleural infection has been the result of seepage or the perforation of a small subpleural abscess, no additional procedure is required. On the other hand if there has been a small or inadequate perforation of a comparatively large pulmonary focus it is imperative that the lesion be adequately laid open to insure satisfactory drainage. If this is not done the small perforation may become temporarily sealed over only to result in activation of the lesion at a later time. Early in our experience this course of events was noted on several occasions in cases of perforated putrid lung abscess, when the resultant putrid empyema involving the general pleural cavity had been evacuated without visualizing and treating the underlying pulmonary lesion. Several of the patients at a later date had to undergo further operative procedures for the treatment of the lung abscess which was originally present.

After the pulmonary focus has been adequately opened, the entire empyema cavity and the pulmonary focus are packed with iodoform gauze to the limits of all recesses.

3 In those instances in which the empyema is situated entirely beneath the lower lobe and separated from the chest wall on all aspects by the lappet of the lobe which is adherent to the periphery of the diaphragm (Group 1 under Pathology and Pathogenesis¹) the free pleura may or may not have to be traversed in order to drain the collection.

It has been stated before that usually in the presence of medium or large sized collections, the overlying pulmonary tissue that separates the empyema from the chest wall, is quite thin. Furthermore, as a result of the juxtaposition of the intrapulmonary suppurative process, this shell of lung becomes involved by an inflammatory reaction which usually results in its firm agglutination to the adjacent chest wall, as well as to the diaphragm. Under such circumstances, if the operative incision is properly placed, free pleura is not entered and the collection of pus is at once encountered after the chest wall and the underlying thin shell of adherent lung are traversed.

On the other hand, if the collection is small, there may be no widespread overlying peripheral inflammatory reaction and the peripheral portions of lower lobe may be adherent only to the diaphragm but not to the chest wall. This means that the free pleura will have to be traversed, and the adherent lappet detached from the diaphragm, in order to establish drainage. In these cases the operative approach is made low in the chest at the site of the inflying aspirating needle, a segment of rib then excised, and the free pleura entered. The adjacent free pleural cavity is next packed off with gauze. If the pus which had previously been withdrawn into the aspirating syringe is odorless, the assumption that the lesion is not a putrid anaerobic infection is justifiable. One may then proceed to peel the adherent lappet of lower lobe off the diaphragm and evacuate the empyema. The pulmonary lesion is inspected, treated as described if necessary and the cavity packed. Care must be exercised not to displace the gauze which is walling off the free pleural cavity.

In those instances in which foul pus had been previously aspirated, the underlying source of the infection is either a ruptured putrid lung abscess or a ruptured, anaerobically infected bronchiectatic cavity. Because of the danger of widespread, virulent anaerobic pleural infection in these cases, and the fact that the underlying pulmonary lesion must be adequately exposed in order to be properly treated it is advisable if no parietal adhesions exist, to perform the operation in two stages. At the first stage, after the free pleura has been entered, the margin of lower lobe and the adjacent lung are shut off from the free pleura by packing, or by suturing the open edges of the wound down to the lung about the operative field. The wound is then widely packed with gauze to stimulate the formation of adhesions, and thus to assure complete shutting-off of the free pleura. When this has been accomplished the second stage is performed, the empyema evacuated, and the pulmonary lesion treated as described. In the extremely rare instances in which the patient's precarious condition, due to marked toxic absorption renders the evacuation of pus urgent, the two stages may be combined and performed at one operation.

From the foregoing statements in regard to the drainage of collections which are situated entirely beneath the lower lobe, it is evident that the larger the lesion the simpler is the operative problem. It is therefore, always wise, if the patient's condition permits, to delay operation until such time as the lesion has reached large size or a parietal extension has developed. Both of these eventualities permit the operation to be performed in one stage. In the event, however that the patient's condition makes operation imperative one should proceed immediately. This is neces-

ary most often in cases in which anaerobic organisms that give rise to virulent putrid infections are present.

3 In some instances as previously stated certain features of the history, clinical course, and physical examination warrant the assumption that an intrapulmonary collection exists, even though the X ray examination is not conclusive and exploratory aspiration does not disclose it. If the patient is observed for a sufficient period of time, the lesion usually becomes more evident due to an increase in size. Expectant treatment is, therefore, advisable until this occurs. On the other hand, in the rare instances in which the lesion does not become more obvious and the grave condition of the patient does not warrant further observation, exploratory operation may very occasionally be indicated. The operative approach is made over the posterior aspect of the lower chest at a level best indicated by the height of the diaphragm. A segment of rib is removed and aspiration performed. If repeated aspiration is negative the pleura is opened and the further plan of procedure, as described, is followed.

The postoperative treatment in practically all cases consists in changing the packings periodically until the cavity becomes obliterated by the expansion of the lung. The first dressing is usually done at the end of about a week, unless there is evidence of retention within the wound or the discharge is unusually profuse. Repacking of the wound is performed under direct vision, retractors being used to obtain full exposure, and a sterile examining light to afford adequate illumination. Care is taken to pack the cavity to its limits and thus to avoid the shutting off of infected recesses and the irregular expansion of the lung. Subsequent dressings are done at intervals of about 4 or 5 days and the lung is allowed to expand gradually and evenly. When the cavity has shrunk to small size all packings are left out, and the wound is allowed to heal. The general care differs in no respect from that of patients with empyema of the usual variety.

Obliteration of the empyema cavity is usually prompt and secondary procedures in the event of slow healing have not been found

necessary. In the event of slow obliteration however, crushing of the phrenic nerve through a cervical approach suggests itself provided the diaphragm is mobile. This procedure causes the diaphragm to rise as a result of temporary paralysis, and thus tends to decrease the size of the dead space. Within a period of several weeks or months during which time the cavity becomes obliterated the mobility of the diaphragm slowly returns and eventually again becomes normal.

RESULTS OF TREATMENT

Of the 12 patients 11 were treated surgically in the general manner described. In the other instance (Case 9) after the removal of a foreign body from the right lower lobe bronchus, the pulmonary process subsided and following the aspiration of an intrapulmonary collection of thin pus, the effusion did not re-accumulate.

In the 12 cases, there were no deaths attributable to the pleural infection or to the procedure employed. One patient (Case 10) with a chronic putrid lung abscess which ruptured, died at a later date with the picture of metastatic cerebral involvement from the original lung abscess. At the time of death the empyema cavity was healing and was considered to be in no way related to the fatal termination. The 11 remaining patients made uncomplicated recoveries.

ABSTRACTS OF CASES

CASE 1 F.M. female aged 39 years November 2 1931 to December 13 1931. Diagnosis Chronic cardiovascular disease. Auricular fibrillation. Pulmonary infarction with necrosis, resultant intrapulmonary pyopneumothorax.

Patient's history was typical of pulmonary infarction with development of pneumonia in the right lower lobe. X ray examination on admission revealed the presence of infiltration in the lower lobe and intrapulmonary pyopneumothorax (Fig. 5). Because of the patient's precarious condition as a result of the pleuropulmonary infection together with cardiac decompensation preliminary closed drainage was performed according to the author's method (7, 8). Twenty three days later thoracotomy rib resection and drainage were performed, after the general condition had improved. A large necrotic infarct involving the base of the lower lobe together with a pyopneumothorax were found. The lower lobe was widely elevated. Convalescence was uneventful (Fig. 6 Group 3 lesion).

CASE 2. A.P., female, aged 14 years, December 14, 1929 to January 30, 1930. **Diagnosis:** Postpneumonic infrapulmonary empyema.

History was typical of pneumonia of right lower lobe. Clinical course after crisis suggested empyema. X-ray examination revealed only infiltration in the lower lobe. Repeated aspiration was negative at the end of 24 days finally positive. At operation, infrapulmonary empyema with small parietal extension was found. Bacteriology: pneumococcus type 1. Convalescence was uneventful. Group 3 lesion.

CASE 3. C.F., female, aged 54 years, January 3, 1930 to January 28, 1930. **Diagnosis:** Postpneumonic infrapulmonary empyema.

Patient's history was typical of pneumonia of the right lower lobe. The clinical course after crisis suggested empyema. X-ray examination revealed only infiltration in the lower lobe. Aspiration of chest was positive. At operation a ruptured subpleural pneumococcus type 2 abscess was found on the under surface of the lower lobe. Infrapulmonary empyema with small parietal extension was present. Convalescence was uneventful. Group 3 lesion.

CASE 4. C.S., male, aged 44 years, March 28, 1930 to May 6, 1930. **Diagnosis:** Postpneumonic infrapulmonary empyema. Patient's history was typical of extensive lobar pneumonia of the right upper and lower lobes, associated with atelectasis. Subsequent course was suggestive of empyema with signs of fluid posteriorly. There was clinical evidence of atelectasis, i.e., displacement of trachea and heart toward the involved side. Diaphragm appeared elevated (Fig. 8). At operation, infrapulmonary empyema with parietal extension (posteriorly) was found. Appearance of elevated diaphragm was due to infrapulmonary collection. Bacteriology: pneumococcus type 3. Convalescence was uneventful (Fig. 9). Group 3 lesion.

CASE 5. J.D., female, aged 54 years, January 18, 1931 to February 28, 1931. **Diagnosis:** Acute putrid lung abscess with rupture, and secondary infrapulmonary empyema. Patient said she had suffered a sudden onset of pain in the lower chest, with dyspnea. There was an early development of signs of fluid, and the course was septic. X-ray examination revealed only consolidation of lower lobe. Repeated aspiration was negative but finally positive after 10 days. At operation an infrapulmonary empyema with small parietal extension was found. The underlying pulmonary lesion apparently was a small putrid abscess, without known etiology (6). Bacteriology: gram positive anaerobic bacillus. Convalescence was uneventful. Group 2 lesion.

CASE 6. L.W., male, aged 28 years, September 15, 1928 to November 6, 1928. **Diagnosis:** Chronic putrid lung abscess with rupture and putrid infrapulmonary empyema.

There was X-ray evidence of a small empyema at the extreme base posteriorly which was noted only on lateral films. At operation, a small infrapulmonary empyema with parietal extension was found and evacuated. Bacteriology: mixed anaerobes.

Convalescence was uneventful. Subsequent drainage of multiple lung abscesses at other sites was carried out. Group 3 lesion.

CASE 7. R.S., female, aged 40 years, February 1, 1930 to March 18, 1930. **Diagnosis:** Postpneumonic infrapulmonary empyema.

X-ray examination disclosed only a large empyema in the posterior part of the chest (Fig. 10). At operation, this was proved to be a large parietal extension of an original infrapulmonary empyema. Bacteriology: pneumococcus type 2. Convalescence was uneventful. (Figure 11 was taken after operation.) Group 3 lesion.

CASE 8. W.B., male, aged 20 years, April 10, 1930 to May 11, 1931. **Diagnosis:** Chronic postpneumonic infrapulmonary empyema. One year before, patient was operated upon at another hospital for left-sided empyema. The wound healed in 3 months, but subsequently re-opened and drained on several occasions.

At operation, an infrapulmonary empyema was found communicating by means of a narrow tract with an area of parietal extension. The lesion was widely exposed and packed. Bacteriology: pneumococcus type 4. Convalescence was uneventful.

The case illustrates the evolution of a chronic empyema due to the presence of an unsuspected, inadequately drained infrapulmonary pocket which was not discovered at the time of original operation because of inadequate exposure. This lesion caused infection to be maintained in the parietal extension, with failure of healing. Group 2 lesion.

CASE 9. L.I., male, aged 38 years, November 19, 1931 to January 13, 1932. **Diagnosis:** Sympneumonic infrapulmonary empyema. History of aspiration of foreign body (chicken bone) 11 weeks previously. Subsequent development of pneumonia of right lower lobe due to occlusion of lower lobe bronchus by the foreign body. Then the development of infrapulmonary empyema. X-ray with induction of pneumoperitoneum was necessary to differentiate the lesion from a high diaphragm.

The foreign body was removed bronchoscopically. On aspiration of chest, effusion was found to be thin and cloudy. It contained 14,000 leucocytes per cubic millimeter with 80 per cent polymorphonuclears. Smear and culture were negative. Following removal of the foreign body the pneumonitis cleared and effusion did not recur. Group 3 lesion.

CASE 10. H.K., male, aged 43 years, February 3, 1932 to March 6, 1932. **Diagnosis:** Chronic putrid lung abscess with rupture and putrid infrapulmonary empyema.

The lesion was demonstrated by the X-ray. A posterior empyema was also seen. After the posterior empyema was drained, the infrapulmonary

collection was later evacuated by peeling the lappet of lower lobe, from the diaphragm. The lung abscess which was the cause of the lesions was found in the lappet. It had ruptured in two directions giving rise to the two empyemas, which were anatomically separated from one another. Bacteriology mixed anaerobes. Patient died at a later date with the picture of metastatic cerebral involvement. Group 1 lesion.

CASE 11. C.D., male, aged 54 years, April 16 1932 to May 25 1932. Diagnosis. Postpneumonic intrapulmonary empyema. The history was typical of lobar pneumonia followed by clinical course of empyema but with signs interpreted as being due only to infiltration in the lower lobe (Fig. 1). Later these developed signs of fluid posteriorly at base adjacent to vertebral column, and the presence of fluid was verified by the X-ray. Operation revealed a small intrapulmonary empyema, with a large parietal extension. Bacteriology pneumococcus type 3. Convalescence was uneventful. Group 1 lesion.

CASE 12. D.H., female, aged 15 years, June 11 1932 to July 14, 1932. Diagnosis. Postpneumonic intrapulmonary empyema. The diagnosis was made on the basis of the clinical course which suggested intrapleural suppuration. There were signs of dullness at the base, despite several negative chest aspirations. X-ray examination revealed cardiac displacement and a shadow in the lower chest, the exact site of which was not entirely clear. After drainage of the intrapulmonary empyema, a parietal empyema which was entirely separate from the former was later found and evacuated. The causative pulmonary lesion, a ruptured subpleural abscess was situated in the lappet of lower lobe and had ruptured in two directions giving rise to the two separate empyemas. (Same as in Case 10, H.K.) Bacteriology pneumococcus type 1. Convalescence was uneventful. Group 1 lesion.

SUMMARY

1 Intrapulmonary empyema is a variety of encapsulated empyema interposed between the under surface of the lower lobe of the lung and the diaphragm

2 The essential feature of the pathogenesis in the group of cases under discussion, is the presence of an infective lesion involving the basilar portion of the lower lobe with the subsequent development of a suppurative process in the subjacent intrapulmonary pleural space

3 The organisms present vary according to the type existing in the underlying pulmonary source of infection

4 The cases are divided into three groups and each group described

5 The symptomatology, physical signs, X-ray findings, diagnostic methods, and differential diagnosis are discussed

6 The significant features in the diagnosis of early cases are

a. History and clinical course suggesting intrapleural suppuration, the site of which is not apparent.

b. Co-existence or history of pain and tenderness of diaphragmatic origin

c. Physical signs of infiltration in the lower lobe, with or without signs suggesting fluid

d. X-ray evidence of infiltration in the lower lobe without evidence of pleural effusion, and sometimes with cardiac displacement

e. Negative result on superficial chest aspiration

7 The surgical treatment of the various types of intrapulmonary empyema is described

8 The results of treatment are presented

9 Twelve abstracted case histories are presented

The author wishes to express his indebtedness to Dr Harold Neuhoef for his helpful suggestions and constructive criticism.

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A STUDY OF THE VESICAL END OF THE URETER IN
HYDRONEPHROSIS¹

A REPORT OF FIFTEEN CASES

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WHEN infants and children are examined and pyelograms after either intravenous injection or the injection of opaque media from below are made and show dilatation of the kidney pelvis and ureter a diagnosis of stricture of the ureter with hydronephrosis and hydroureter is suggested.

Because of the general interest in the subject of stricture of the ureter in adults, and because hydroureter with hydronephrosis is frequently found in children we became interested in determining whether or not in these cases the obstruction at the lower end of the ureter was due to stricture in the generally accepted interpretation of that word.

According to Braasch and Frater a stricture is a narrowing beyond the normal anatomical and physiological limits, of a hollow muscular tube. Microscopically a stricture may show (a) changes in the epithelium such as destructions (b) narrowing of the lumen to complete obliteration (c) evidence of inflammatory reaction such as leucocytic collections in the wall of the ureter (d) increase in fibrous tissue normally present and (e) hyalinization of muscle.

The histological study in our cases, instead of showing the foregoing requisites for stricture, showed that the obstruction which produced the hydroureter and hydronephrosis was due to hypertrophy of the muscular longitudinal fibers with few exceptions to anomalous insertions of the ureters. Inflammatory changes were of recent origin only and were not the cause of the essential primary narrowing of the lower ends of the ureters.

This paper is based on a series of 15 post mortem specimens from the Children's Memorial Hospital of Chicago.

CASE 1.² R. C., male aged 1 month admitted to the Children's Memorial Hospital September 12

Previously reported in "Congenital valves of the posterior ureters (Kretschmer and Pearson). Am. J. Dis. Child., 9:61, 1910, 1911.

From the Children's Memorial Hospital and from the A. D. Thompson Urological Fund of Rush Medical College of the University of Chicago. Read at the Annual Meeting of the American Association of Genito-Urinary Surgeons, May 24, 27 and 28, 1913, at Niagara Falls, Canada.

1917 on account of projectile vomiting. There were no urinary symptoms. The physical examination was negative except for a slight injection of the throat and a questionable walnut-sized mass in the right upper quadrant. Peristaltic waves were visible. The urinalysis was negative. A tentative diagnosis was made of pyloric obstruction and operation was advised. On September 12 1917 an exploratory laparotomy was performed. No pyloric tumor was found. Temperature varied from 100 to 102 degrees following the operation. The child died on the second day following the operation. The clinical diagnosis was bronchopneumonia. An autopsy was done on September 15, 1917. The anatomical diagnosis was congenital valve in the posterior urethra hypertrophy and dilatation of the urinary bladder hydroureter and hydronephrosis, bilateral, with infection (streptococcus) and a bronchopneumonia.

Description of specimen. The kidneys show a moderate amount of hydronephrosis. The renal pelvis are dilated. The ureters are dilated from the renal pelvis down to the bladder wall. The degree of dilatation is as marked at the bladder as at the upper end. The wall of the bladder is enormously dilated, but there are no evidences of trabeculation. The ureteral orifices appear normal.

The intramural part of the ureter appears thick and rigid. Further examination shows that the dilatation begins at the juxtavesical part of the ureter. The ureters are enormously dilated and tortuous, and the walls are thin. When the dissection of the ureters is carried through the wall of the bladder it is noted that the intramural parts of the ureters are thickened but not dilated.

Histology. In serial sections of the juxtavesical portion of each ureter the lumen is contracted and has thick epithelium of long cells, and a rather narrow mucous membrane. At least three fourths of the ureter wall consists of muscle fibers, most of which are longitudinal, and only a few are circular fibers. The muscle is in small bundles separated by delicate fibrous reticula.

The serial sections of both ureters are essentially identical. Muscle hypertrophy is marked and in the lower ureter distal to the juxtavesical portion the circular and longitudinal fibers are about equal in amount.

In the midportion of the ureters their walls are thin, the lining epithelium is narrow the mucous membrane practically obliterated, and the structure is largely muscular circular and longitudinal fibers being equally distributed. The peripheral connective tissue is scant.

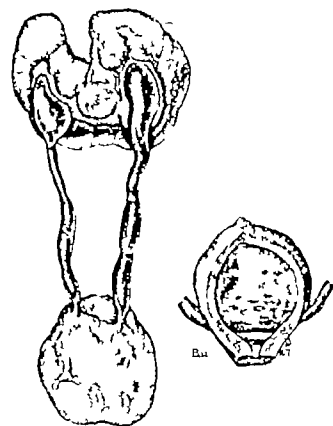


Fig. 1. Case 2. Horseshoe kidney with bilateral dilatation of kidney pelvis and ureters. The dilatation terminates about 5 centimeters above the bladder. Bladder wall thickened. Note presence of bar.

There is extensive hyalinization of the bladder musculature. The bladder wall is only slightly thicker than the wall of the ureter.

CASE 2. C. M. male, aged 1 year admitted March 18, 1931. The infant had a spina bifida and a painless swelling of the left thigh and left leg of 1 week's duration. When born there was a swelling on the back about the size of half an egg and this discharged for 2 or 3 months. There was marked incontinence of urine. Examination revealed a pale, fat and apparently ill infant. There was marked swelling of the left lower extremity from the hip to and including the foot, marked bilateral calcanoequinovalgus. Knee jerks were absent. Roentgen ray examination revealed fracture of the left femur. The child ran a septic temperature which rose to 105 degrees daily. Examination of the urine showed albumin and a small amount of pus. Subsequently bilateral otitis media and bronchopneumonia developed and the child died on April 15, 1931. The clinical diagnosis was spina bifida, talipes equinovagus, fracture of the femur, bronchopneumonia, otitis media, secondary anemia. Autopsy was done on April 16, 1931. The anatomical diagnosis was horseshoe-shape kidney, hydroureters and hydronephrosis, extensive bilateral bronchopneumonia, spina bifida, talipes equinovagus, fracture of the femur, generalized anemia, acute otitis media.

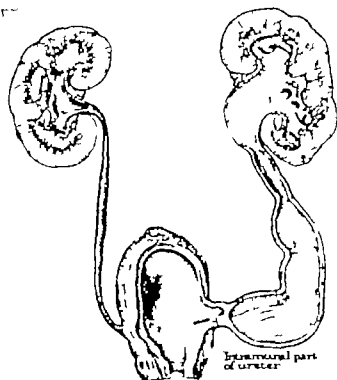


Fig. 2. Case 3. The left ureteral orifice is normal. Intramural part of the ureter not dilated. Dilatation of ureter begins above the bladder. Note presence of superficial diverticulum.

Description of specimen. The kidneys are completely fused at the lower poles and have a separate blood supply and each half has a separate pelvis (Fig. 1). Both renal pelvises are equally dilated.

The ureters are dilated, the left more so than the right. The dilatation extends from the ureteropelvic junction down to a point about 5 millimeters above the bladder on the right side and about 4 millimeters above the bladder on the left side at which point the ureter is of normal circumference and thickened. Below this point the ureter approaches the normal and the intramural part is normal.

The bladder wall is thickened and shows some trabeculations with superficial cellulitis and the presence of a median bar. The ureteral openings are normal.

Histology. In serial sections of the lower end of each ureter the walls are thick, the lumen contracted and lined with stratified epithelium in folds. There is practically no subepithelial mucous membrane. The thickness of this contracted portion is composed essentially of muscle fibers, the longitudinal fibers predominating. These fibers are encased in connective tissue extending to the periphery.

Directly above the juxtavesical portions the lumen is larger, its diameter being at least twice as great as below. Here the muscle hypertrophy is marked, but the fibers are farther apart and the connective tissue less dense.

Similar serial sections of a portion of the midureter and upper ureter are thin. This thinness is in all the layers. The mucous membrane is almost absent.

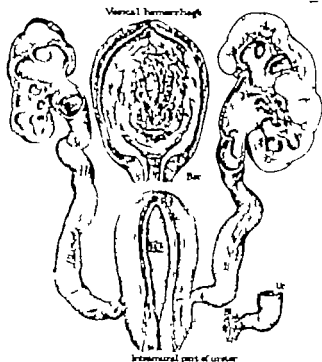


Fig. 3. Case 4. Enormous dilatation of the kidney pelvis and ureters down to the bladder wall. Intramural part of the ureter not dilated. Insert: Thickening of trigone and bladder wall. Presence of median bar.

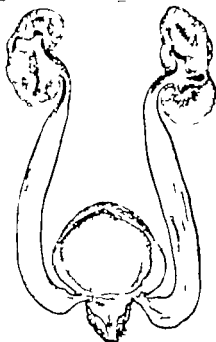


Fig. 4. Case 6. The ureters were uniformly thickened and dilated nearly to the bladder wall.

CASE 3. T. S., male, aged 12 months, admitted September 3, 1925. The following symptoms: intense restlessness, fever, diarrhoea vomiting and loss of weight, began 1 week prior to admission to the hospital. Urinary symptoms were absent. Examination revealed a well developed, dehydrated infant. Physical examination was negative. Temperature on admission was 102.6 degrees. Examination of the urine showed a large amount of pus and albumin and *Bacillus coli* on culture. Death occurred 16 hours after admission to the hospital. The clinical diagnosis was alimentary intoxication. Autopsy was done September 3, 1925. The anatomical diagnosis was emaciation and generalized anaemia, hydronephrosis and hydronephrosis, left ectopic right kidney.

Description of specimen. Fetal lobulations are noted in the right kidney otherwise normal (Fig. 2). The right ureter measures 85 millimeters in length. A slight evidence of dilatation is noted in the left kidney. The left ureter from its orifice to the ureteropelvic junction measures 175 millimeters. It is not tortuous, the walls are thickened and dilated. The point of maximum dilatation 35 millimeters in circumference is about 30 millimeters above the ureteral orifice. Below this point of maximum dilatation the ureter is 4 millimeters in diameter, its intramural part is apparently normal. The bladder wall shows well defined hypertrophy and the

presence of a small diverticulum at the site of insertion of the left ureter into the bladder. The autopsy records of this case fail to state whether or not obstruction was present at or in front of the neck of the bladder.

Histology. The serial sections of the lower portion of the left ureter contain a part of a bladder diverticulum behind which is the narrow ureter. The epithelium here is narrow and generally only two cells high. The mucous membrane varies in amount but is generally thick and extends centrally into the folds of the epithelium, being well defined peripherally where it joins the muscularis. Here the muscle bundles, each bundle consisting of compressed fibers, are clumped together. These bundles are generally three to five times the usual size and about two-thirds of them consist of longitudinal fibers. In cross sections, portions of the wall are without muscle fibers between the lumen and periphery and it is in the periphery that the fibers are clumped. In serial sections higher up in the ureter the wall is thin, the epithelium narrow, the mucous membrane absent and the essential content of the wall is the muscularis. Throughout all sections of the ureter there is a rather extensive infiltration of lymphocytes into the lining mucous membrane.

CASE 4. D. W., male aged 4 years, admitted March 8, 1919, on account of fever, cough, loss of appetite, and constipation. Incontinence of urine



Fig. 5

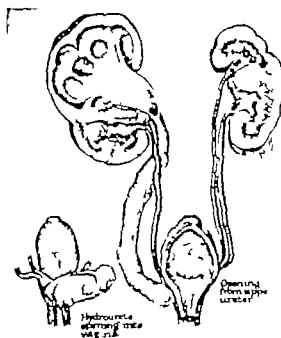


Fig. 6.

Fig. 5, left. Case 7. Note thickening of intramural and juxtavesical part of the ureter with dilatation above for about 45 millimeters. Thickening of wall of ureter above this part.

Fig. 6. Case 8. Note enormous dilatation of the ureter draining the upper half of the right double kidney into the vagina. Insert, Showing insertion of ureter into the vagina.

was noted on admission, the child was wet all the time. Temperature 102.4 degrees. The child appeared to be acutely ill. There was a slight discharge from the nose. The tonsils were large and covered with a yellow mucous material. The lungs revealed many mucous râles, posteriorly from the third to the ninth ribs on both sides. In the abdomen was a suprapubic tumor which disappeared after catheterization but on the following day the tumor reappeared. After each catheterization the tumor disappeared. Examination of the blood showed white cells 17,000 red cells 5,150,000 hemoglobin 70 per cent. Examination of the urine showed pus and *Bacillus coli* on culture. Death occurred on March 31, 1919. The clinical diagnosis was acute pyelocystitis obstruction at the neck of the bladder retention of urine. Autopsy was done March 31, 1919. The anatomical diagnosis was multiple abscesses of the kidneys bilateral hydronephrosis with infection dilatation of ureters median bar chronic cystitis hypertrophy of bladder wall, congenital valve in posterior urethra.

Description of specimen (Fig. 3). The left kidney is three times the size of the right the surface is studded with many millary abscesses. A moderate amount of hydronephrosis is noted. The right kidney is almost completely destroyed by hydronephrosis. Only a small amount of renal tissue remains at

the upper pole. The ureters are dilated very tortuous, and the walls are decidedly thickened. The dilatation extends from the ureteropelvic junction down to the bladder. The intramural part of the ureter is thickened but not dilated. No evidence of narrowing of the lumen is noted. The dilatation begins above the intramural part of the ureter. The bladder wall is thick, the mucosa rough and markedly hyperemic, in places mottled with recent hemorrhages most marked on the back portion. The interureteric ligament is thickened. The ureteral openings are normal. A median bar and a congenital valve in the posterior urethra are present.

Histology. Serial sections were studied from fourteen blocks of different portions of the ureters. The lining mucous membrane was swollen in all of them and was the site of subacute and chronic inflammation with a purulent exudate into the lumen. From the intramural portions distally to the kidneys the changes of both ureters were identical. In the intramural, and especially in the juxtavesical portions of the ureters the muscle fibers were so greatly enlarged that in places the thickened wall had muscle fibers for four fifths of its thickness. The longitudinal fibers were slightly more abundant than the circular ones, many of which had undergone hyaline degeneration. Everywhere the mucous membrane was narrow.



Fig. 7. Case 9. Inserts showing dilatation of ureters down to the bladder wall. Intramural part of ureters thickened but not dilated. Note median bar and all in ureters. Trigone thickened.

As the ureters were followed to the kidney the wall became less thick, the predominance of circular and longitudinal fibers varied and were more nearly normal in amount.

CASE 5. D. S. female, aged 32 days, was first admitted November 5, 1928. The significant findings at that time were otitis media and a prolapsed rectum together with exstrophy of the bladder. Examination of the urine showed a few pus cells only. On second admission, March 19, 1929, the child was admitted because of a prolapsed rectum and an acute attack of pyelitis. The infant subsequently developed bronchopneumonia and died on March 26, 1929. The clinical diagnosis was exstrophy of the bladder, acute pyelonephritis, prolapse of the rectum, otitis media, bronchopneumonia, empyema, right. Autopsy was done March 26, 1929. The anatomical diagnosis was exstrophy of the bladder, subacute cystitis and ureteritis, diffuse bronchopneumonia, empyema, ventral hernia.

Description of specimen. The urinary bladder is present in the front abdominal wall in the midline just above the symphysis pubis for a place 4.5 centimeters in diameter. It is sharply defined from the

adjacent, pale white skin, because of its dark red, crumpled lining which is curled up in folds. Two ureteral openings are present, and normal within the wall of the bladder.

On the right side just above the bladder, the ureter is thin walled and dilated so that it is about twice the size of the left ureter which is normal throughout its course. The dilatation of the right ureter is present for 5 centimeters above the bladder and above this place it is normal. Below the place of dilatation of the right ureter which is the juxta-vesical portion, this ureter is a contracted, rigid tube continuous through the bladder wall. The pelvis of each kidney and the kidneys, are normal.

Histology. Serial sections were studied of the lower ends of the ureters from the abdominally exposed portions and upward for 3.8 centimeters, also serial sections of each ureter in its midportion. In the lower portion the wall consists almost entirely of epithelium of four to six cells thick, and loose mucous membrane in which small bundles of muscle fibers are enmeshed. These are predominately longitudinal fibers. Circular fibers are sparse. Chronic inflammation is extensive, in all portions,

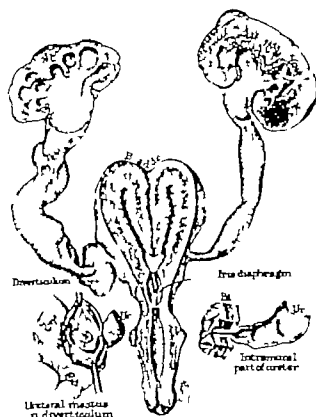


Fig. 8. Case 10. The right ureter empties into a diverticulum. Bladder wall enormously thickened. Iris type of valve in urethra. Intramural part of ureter thickened. Juxtavesical portion of left ureter thickened with dilatation above.

although most marked in the lining. Distally from the abdominal wall the findings are similar, except that the epithelium is less thick. In isolated places however, the muscle fibers become prominent only to diminish quickly as the ureter is ascended. In the midportions of both ureters the walls are normally thin, the epithelium is narrow the mucous membrane almost absent, and the thickness is largely that of the muscularis. The longitudinal fibers become less prominent so that near the kidneys the circular fibers predominate.

CASE 6 F. L. female, aged 8 years, was admitted February 5, 1929, because of inability to walk, a sore throat, and marked irritability. The present complaints began a week ago with sore throat and fever. Three days before admission to the hospital the patient had a spell of vomiting and 2 days later she was unable to walk. Recently she has been having some difficulty in swallowing. Examination revealed a well developed and well nourished female. The pharynx was moderately inflamed no membrane and no paralysis. The heart, lungs, and abdomen were negative. Reflexes were as follows: knee jerks, faint; Kernig's sign negative; abdominal, present; Babinski, not elicited. Examination of the blood showed red cells 4,500,000; white cells 18,600; hemoglobin 80 per cent. Blood chemistry showed non-protein nitrogen, 165; urea nitrogen, 145; and uric acid 9. Blood pressure was systolic 90 and

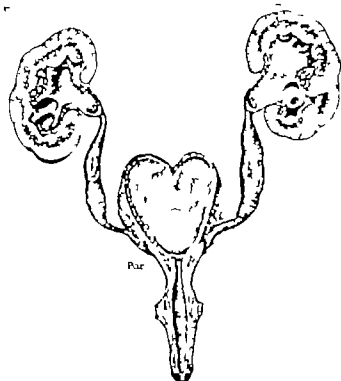


Fig. 9. Case 11. Note the dilatation of the bladder and presence of a median bar with dilatation of ureters above.

diastolic 80. Von Pirquet and Schick tests were negative. Examination of the urine showed albuminuria, and a few casts. The patient developed a bronchopneumonia and died March 3, 1929. The clinical diagnosis was post-diphtheritic paralysis. Autopsy was done March 3, 1929. The anatomical diagnosis was chronic diffuse nephritis, bilateral hydroureters, chronic hyperplastic ureteritis, bronchopneumonia, caseous and calcified tuberculosis of lungs, parabranchial and mesenteric lymph glands.

Description of specimen (Fig. 4). There is a moderate amount of hydronephrosis more marked on the right side. The right ureteropelvic junction is slightly narrower than the left. Both ureters show enormous dilatation. The walls are greatly thickened, the ureters are not tortuous, but resemble thick rigid tubes. The dilatation extends almost to the bladder wall.

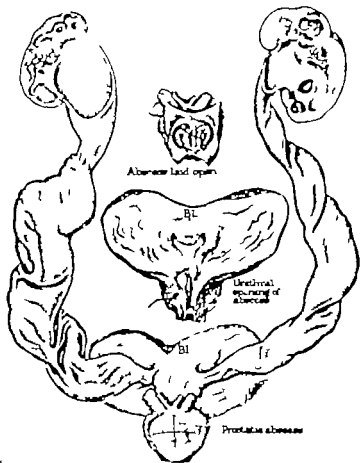
Histology. Serial sections of the ureters were studied in ten different places and include all of the lower ureter. The sections of each ureter were essentially similar. In the intramural portion the epithelium and entire mucous membrane were swollen and of loose cellular structure. Two separate lymph nodes were present within the mucous membrane of the right ureter in its lower portion. In the bladder wall, the muscle layer of the ureter was retained as small bundles enmeshed in loose connective tissue.

Just above the intramural portions, the lining epithelium and the mucous membrane were similarly swollen but the ureter thickness was greatly increased. This increase in size applied to the muscle bundles, about three fourths of each bundle being



Fig. 10, left Case 12. Uniformly dilated thin walled ureter. Intramural and juxtavesical part of the ureter thickened, due to muscle hypertrophy.

Fig. 11, right Case 15. Note enormous thickening and dilatation of ureters beginning above the juxtavesical part. Probe passed through openings of prostatic abscess. Dotted line indicates incisions made in opening the prostatic abscess. Hydro-nephrosis, bilateral.



made up of longitudinal and one-fourth of circular fibers. The hypertrophy of muscle fibers was most marked in the peripheral portions of the sections. As the ureter was followed upward, the muscle hypertrophy persisted, but the predominance between longitudinal and circular fibers varied at different levels. All the muscle fibers stained well.

The lining of the ureter throughout its entire course was diffusely infiltrated with leucocytes in which the lymphocytes predominated. The inflammation was essentially of the mucous membrane.

CASE 7. H. P. male, aged 7 months, admitted February 11, 1921, complaint, emaciation. Infant was a twin, full term, in a weakened condition at birth. Other infant has done very well, but this one failed to gain and emaciation has progressed since birth. Examination revealed an extremely emaciated child showing marked weakness. The skin was wrinkled and pasty grey in color. The head, neck, and heart were negative. There were distinctive signs of a disseminated bronchopneumonia. Emaciation of extremities was marked. Examination of the urine showed albumin and leucocytes. Death oc-

curred on February 15, 1921, four days after admission. The clinical diagnosis was bronchopneumonia atrophy extreme. Autopsy was performed February 16, 1921. The anatomic diagnosis was bilateral bronchopneumonia, congenital stenosis of the left ureter, left hydronephrosis and hydronephrosis ectopic right kidney.

Description of specimen. The right kidney is normal. The right ureter measures 78 millimeters from the bladder to the ureteropelvic junction. There is a fusiform dilatation 16 millimeters long and 6 millimeters wide in the lower one half of the ureter. The ureteropelvic junction is normal. The ureteral orifices and the internal urethral orifice are normal. The ureter just above the bladder shows decided thickening. The left kidney contains fetal lobulations, and when opened reveals dilatation of the pelvis and a moderate hydronephrosis. The ureter measures 100 millimeters in length, and presents an unusual picture. At the ureterovesical junction it appears thickened for a distance of 7 millimeters. The next 45 millimeters are enormously dilated and the wall is unusually thin (Fig. 5). Above this point

of great dilatation the ureteral wall is enormously thickened, and midway between the previously described dilatation can be seen two transverse ridges. The pelvis is thin. There is no evidence of bladder neck obstruction.

Histology Serial sections of the ureter were studied in eight grossly different places. These included the entire lower ureter on each side.

In the intramural and juxtavesical portions of the ureters the lumen is contracted, its lining being compressed into folds with an epithelial lining 3 to 5 cells thick. Here the mucous membrane reticulum is abundant but in the peripheral portions the longitudinal muscle fibers are at least twice the usual amount. The circular muscle fibers are normal. The fibers stain well. Except for one focal place where fibrous tissue is clumped inside the ureter wall, the mucous membrane is composed of loose connective tissue. Directly above the contracted juxtavesical portion the ureter balloons out, especially on the left side and the wall is thin. The lining epithelium is narrow, the mucous membrane connective tissue almost absent and the prominent muscle fibers are almost entirely circular. Above the dilated portion of the ureter the wall is again thick. The thickness consists of high epithelium, mucous membrane and muscle fibers, circular and longitudinal in almost equal proportion.

CASE 8. D F, female aged 6 weeks, admitted August 18, 1927 because of vomiting of one week's duration and diarrhoea for 10 days. Vomiting, not projectile in character, occurred directly after feeding. There were four to five loose watery stools daily. No urinary symptoms. Examination revealed a very small dehydrated baby. Physical examination was negative except for a moderate injection of the pharynx and a palpable liver. Examination of the blood showed red cells 3,600,000, white cells 15,400, haemoglobin 62 per cent. A specimen of urine made postmortem showed many pus cells. Death occurred on August 20, 1927, 20 hours after admission. The clinical diagnosis was gastro-enteritis. Autopsy was performed August 20, 1927. The anatomical diagnosis was bilateral duplication of the kidney pelves and ureters, pyo-ureter and pyonephrosis of upper half of the double right kidney, ectopic ureter (right upper) opening into the vagina.

Description of specimen (Fig. 6) On the left side the kidney is very much smaller than on the right and there is no evidence of hydronephrosis. There are two separate openings into the bladder. The right kidney shows two pelves and two ureters. The ureter from the lower half and the ureteral orifice are normal. The ureter that drains the upper half of the double kidney is markedly dilated, thin walled, and tortuous and it runs under the bladder and urethra terminating in the vagina. At the point of entrance of the ureter into the vagina there is a definite ring constriction. The opening of this aberrant or ectopic ureter is only 2 millimeters in circumference, at which point the ureter is dilated and measures 24 millimeters in circumference. There is no evidence

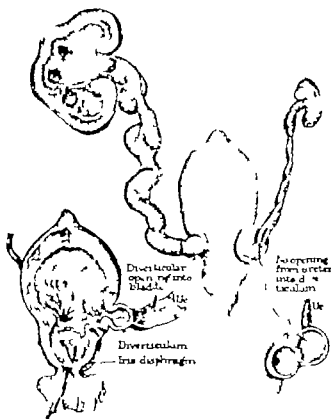


Fig. 12. Case 14. Note blind insertion of right ureter into a diverticulum. Aplasia of right kidney. The left ureter passes behind another diverticulitis. Iris valve in posterior urethra.

of obstruction in the bladder or urethra. The pelvis is exceedingly thin as is the rest of the ureter and there is a marked hydronephrosis with compression atrophy of the corresponding half of the kidney. There remains only a very thin shell of kidney tissue.

Histology Of the ureter which comes from the upper one half of the right kidney serial sections are made of the entire lower portion upward from its opening into the vagina up to include its juxtavesical portion. Serial sections are also made of the mid portion of the ureter. At the vagina, the lining of the ureter is in folds of thickly cellular epithelium, immediately beneath which the mucous membrane consists of dense, ramifying fibrous tissue which occupies about one half of the thickness of the ureter. This fibrous tissue spreads outward and surrounds and compresses small bundles of longitudinal muscle. These muscles have undergone extensive hyaline degenerative changes. The fibrous tissue continues peripherally to the large and rather dense strands of circular muscle which is the essential peripheral layer of the ureter. These changes are present similarly throughout all sections up to and beyond the juxtavesical portion. In the midportion of the ureter the lining epithelium is similarly thick, and the mucous membrane is practically absent. Here the essential content of the wall is of smooth muscle, three fourths of which is circular fibers. Throughout all sections



Fig. 13. Marked hypertrophy and hyperplasia of muscle bundles (Mucous membrane removed)



Fig. 14. Typical hypertrophy of the tunica muscularis. (Mucous membrane removed)



Fig. 15. Hypertrophy of longitudinal muscle fibers of the lower end of ureter (Hematoxylin and eosin stain)



Fig. 16. Hypertrophy of muscle fibers of lower end of the ureter (Van Gieson stain.)

from the vagina upward there is an infiltration of lymphocytes especially into the mucous membrane, and in places the lymphocytes are in clumps adjacent to muscle bundles. In the ureter the changes are those of diffuse fibrosis, compression-atrophy of longitudinal muscle bundles, and chronic inflammation.

CASE 9. R. M. male aged 20 months, admitted October 7 1931 because of a mass in the abdomen

and cramp-like pain at the beginning of urination. At 6 months of age the infant had pneumonia and at 14 months, scarlet fever, during which time he passed blood in the urine. The mother stated that 1 month prior to admission she first noticed a "lump in the stomach," that it was larger at times and other times could not be felt. The right kidney was enlarged, irregular in outline and easily palpable. In the midline was felt a suprapubic tumor which was

firm and movable and extended $\frac{3}{4}$ inch below the umbilicus. On rectal examination, there was disclosed a non fluctuant round mass about the size of a butternut in the midline (thickened bladder). Roentgen ray examination of the genito-urinary tract was negative for stone. Two attempts at intravenous pyelography with skiodan failed to visualize the urinary tract. The passage of a soft rubber catheter met an obstruction in the prostatic urethra. The obstruction was finally overcome and 180 cubic centimeters of urine were obtained. Examination of the urine showed albumin, 3+; pus, 4+; no red cells or casts. Culture of the bladder urine revealed streptococci and *Staphylococcus aureus*. A cystogram made at this time showed a bilateral hydronephrosis. Examination of the blood showed red cells, 3,800,000; white cells, 8,400; hemoglobin, 65 per cent; neutrophils 56 per cent and lymphocytes, 44 per cent. Blood chemistry: non protein nitrogen, 112; creatinin, 2; and uric acid 6.5. The infant ran a septic course. Death occurred on October 22, 1931. The clinical diagnosis was congenital anomaly of the urinary tract (probably a vesical neck obstruction or valve) with secondary bilateral hydroureters and uræmia. An autopsy was performed October 23, 1931. The anatomical diagnosis was congenital valve obstruction of the posterior urethra, median bar obstruction, dilatation and hypertrophy of the bladder, diverticulum of the bladder, bilateral hydroureter and hydronephrosis, pressure atrophy of kidneys.

Description of specimen (Fig. 7) The right kidney is enlarged, its surface is irregular, the cortex thin, the pelvis extremely dilated, marked hydronephrosis. Similar changes were noted in the left kidney but it is smaller than the right. Both ureters are markedly dilated and the walls are thin. The dilatation extends from the renal pelvis down to the bladder wall. The intramural part of the ureters is not dilated. Great thickening of the bladder wall is noted. An opening of a diverticulum is seen in the upper right quadrant. There is hypertrophy of the trigone, and the ureteral openings are normal. The presence of a median bar obstruction is seen. The prostatic urethra is dilated, and in front of it is seen a fold of the mucous membrane.

Histology Serial sections were made of the entire lower portion and the midportion of each ureter. The findings of each ureter are essentially similar. In the intramural portion the lining epithelium is narrow, the mucous membrane normally thick, and the inner circular and outer longitudinal muscle fibers are only normally prominent. Just above the bladder however the diameter of the ureter and the thickness of the wall are markedly increased. The lining epithelium and mucous membrane are narrow. The thickness of the wall is due to a marked increase in the size of the muscle fibers in the large bundles held together by loose connective tissue. At least three fourths of the thickness of the ureteral wall is muscle tissue. Here in places the increase of muscle is due to longitudinal fibers in clumps and on

opposite sides of the same block the circular muscle fibers are densely prominent. This variability of muscle prominence is evident throughout all the sections of the lower portions of the ureters. In the midportion of each ureter there is a uniform hyperplasia of all layers, and not of muscle fibers only. Here the longitudinal fibers are central, the circular fibers peripheral. In all sections of the ureter there is evidence of chronic inflammation. This is most marked in the mucous membrane.

CASE 10 R. K. male aged 2 months, admitted October 5, 1931, because of frequent projectile vomiting occurring 5 to 10 minutes after feeding. This symptom has been present since the child was 12 days old. A hard swelling was noted in the lower abdomen which the mother first noticed 3 weeks ago also swelling of the left leg for 2 weeks. The mother stated that the infant urinated very infrequently. Examination revealed a somewhat underweight and mildly dehydrated infant. The abdomen was distended and tense with dilated superficial veins. A suprapubic tumor extending 2.5 centimeters above the umbilicus, was felt in the lower abdomen. The right kidney was palpated but not the left. There was some oedema of the left leg. The cystogram showed a large slightly asymmetrical bladder and a markedly dilated left ureter. The right ureter was not visualized. The intravenous pyelogram failed to show any evidence of dye in the kidney regions or along the course of the ureters. Examination of the blood showed red cells 3,800,000, white cells 18,500, hemoglobin, 55 per cent. Blood chemistry: non protein nitrogen, 42; uric acid 5. Examination of the urine showed albumin, many pus cells, and no casts. The infant was treated by means of indwelling catheter but ran a progressively unsatisfactory course, growing more and more dehydrated in spite of the fluids given parenterally. Death occurred on December 31, 1931. The clinical diagnosis was vesical neck obstruction, bilateral hydroureter with hydronephrosis, uræmia, bronchopneumonia. Autopsy was done January 1, 1932. The anatomical diagnosis was congenital iris valve of the posterior urethra, dilatation and hypertrophy of the bladder with diverticulum formation, bilateral hydronephrosis, atrophy of the left kidney, bilateral pyelonephritis, hypostatic bronchopneumonia.

Description of specimen (Fig. 8) In front of the verumontanum is seen the presence of an iris diaphragm. It completely closes the urethra except for a pinpoint opening, and the prostatic urethra is somewhat dilated. The bladder wall is enormously hypertrophied and there is the opening of a diverticulum at the site of the normal insertion of the right ureter. The right ureter opens into this diverticulum and the right ureteral orifice is normal. Immediately above this diverticulum the ureter is thickened but of normal circumference, but above this point it is enormously dilated, twisted, and sacculated. The pelvis is dilated and the kidney shows hydronephrotic atrophy, with only a small shell of the kidney re-

maining. The pelvis is 48 millimeters in circumference. The left kidney reveals a cortical abscess and moderate hydronephrosis. It measures 44 by 30 by 16 millimeters. The pelvis measures 30 millimeters in circumference and 17 millimeters in length. The lower ureter is thin walled, tortuous, and dilated. At its entrance into the bladder it is thickened and narrowed.

Histology. Serial sections are made of the entire lower end of each ureter. In the left ureter in the intramural portion the lining epithelium is thick, high, and compressed into folds. The mucous membrane is wide and its connective tissue extends peripherally so as to surround small circular muscle fibers, adjacent to which are masses of longitudinal muscle fibers of about uniform size, with poor staining properties. Directly above the bladder the ureter wall is thick. Its lining epithelium is narrow the mucous membrane wide. Here the muscle fibers are prominent and are circular and longitudinal in almost equal proportions. The longitudinal fibers are surrounded by dense connective tissue and in a few places some of them stain poorly, similar to what occurs in atrophy. Immediately adjacent, however, the muscle bundles are markedly hypertrophic and some of them are two to three times the usual size. This hypertrophy continues upward to the portion where the dilatation begins. On the right side, at the point of entrance of the ureter into the diverticulum, the lining epithelium is thick. Here there is a definite increase of fibrous tissue throughout the mucous membrane, and in places it compresses or replaces muscle fibers as in stricture. Directly above this part of the ureter and extending to the dilated part the muscle fibers, especially the peripheral longitudinal ones, are hypertrophic in similar fashion to those of the left ureter. Along the entire course of the ureter and into the kidney proper there are rather extensive changes of acute inflammation.

CASE 11. J. D., male, aged 5 months, admitted January 24, 1932 because of the following complaints. Stiff neck of 3 days' duration, pneumonia for 12 days, fever of 102 to 106 degrees for 18 days, drowsiness, cough, anorexia for 3 days, dyspnea for 1 week, and stiffness of the right arm. There were no urinary symptoms.

Examination revealed a well nourished, acutely ill infant, with labored and irregular respirations. The neck was rigid. There was bulging of both eardrums, an area of dullness over the right chest, anteriorly and posteriorly and bronchial breathing over the entire chest, most marked over the upper lobe. There were a few coarse rales. The heart was normal except for sinus arrhythmia. The abdomen was negative except for considerable distention. The spinal fluid showed *Bacillus influenzae* in pure culture. Death occurred 10 hours after admission. The clinical diagnosis was bronchopneumonia meningitis (influenza) otitis media. An autopsy was done January 26, 1932. The anatomic diagnosis was fibropurulent cerebrospinal leptomeningitis (*Bacillus influenzae*); cavernous sinus thrombophlebitis bil-

lateral purulent otitis media, bilateral bronchopneumonia, fibrino-purulent right pleuritis (*Bacillus influenzae*), serous peritonitis (*Bacillus influenzae*), median bar formation, bilateral hydronephrosis.

Description of specimen (Fig. 9). The bladder is dilated, the wall is somewhat thickened uniformly and the presence of a median bar is noted. The ureteral orifices are normal. The lower ends of the ureters are contracted and the lumen is small. The right ureter, at a point 15 millimeters above the bladder is dilated, the dilatation continues upward to or nearly to the ureteropelvic junction. The left ureter shows dilatation at a point about 5 millimeters above the bladder and this dilatation extends to the ureteropelvic junction. The intramural part of the ureter appears to be of about the same size and structure as the juxta-vesical part. The kidneys show moderate hydronephrosis.

Histology. In serial sections of both ureters, the findings are essentially similar. In the ureters within the bladder wall the lining epithelium and the mucous membrane are normally wide, the muscle fibers scant. At the point where the right ureter enters the bladder the mucous membrane is thick and in places ramified by strands of fibrous tissue which surrounds small bundles of centrally placed longitudinal muscle fibers. As the ureter is ascended, however the central longitudinal and peripheral circular muscle followed upward are markedly increased in size, and they occupy about three-fifths of the entire ureteral wall. In the left ureter from the bladder junction up to the dilated portion of the ureter the muscle fibers are generally huge. The longitudinal fibers are centrally placed, the circular fibers peripheral. This hypertrophy of muscle is of both types, and may be present in a single section, or in zones as the ureter is ascended, where one type predominates over the other. In the upper two-thirds of each ureter the walls are thin. Here the epithelium is narrow the mucous membrane rather diffusely fibrous, and the muscle tissue scanty.

CASE 12. R. O. male, aged 6 weeks, admitted December 9, 1927 because of vomiting. At the tenth to twelfth day of life he began to vomit once daily the vomiting being projectile in type. The frequency of the vomiting gradually increased to three to four times daily after each feeding. He began to cough 10 days ago. For the past 3 days breathing has been very rapid. Temperature upon admission was 97 degrees. Examination revealed a dehydrated and malnourished child breathing deeply and very rapidly no cyanosis. The lungs were negative. There was a systolic murmur at the precordium and apex. The abdomen showed no palpable masses. The extremities were negative. The infant was too ill for a thorough examination.

Examination of the blood showed red cells, 5,700,000 white cells, 16,000 hemoglobin, 36 per cent neutrophils, 73 per cent, lymphocytes, 27 per cent. No examination of urine was made. The following day there was a change for the worse. He vomited dark brown material and a small amount of

mucus. Respirations were rapid and gasping and there were many râles throughout the chest. Pulmonary oedema was noted. Death occurred 30 hours after admission. The clinical diagnosis was pylorospasm, pulmonary oedema. An autopsy was done December 11, 1917. The anatomical diagnosis was marked bilateral hydronephrosis and hydronephrosis with infection, extensive bilateral bronchopneumonia, emaciation, dehydration, generalized anemia.

Description of specimen (Fig. 10) The bladder is dilated half way to the navel. There is marked dilatation of the ureters which are thin walled and have a tortuous course. The pelves are dilated, with marked destruction of the kidney substance. There is marked hydronephrosis. Both ureters are dilated down to the juxtavesical part at which point the walls of the ureter are extremely thick. The bladder wall is also thickened. Both ureteral orifices are normal. There is no obstruction in the urethra.

Histology In serial sections of the right ureter in its lower portion, at, and directly above, the bladder the lining epithelium is thin. In large circular strands and in large longitudinal bundles, the muscle fibers completely surround the lumen and occupy also most of the mucous membrane layer. A few of the large fibers are hyalinized and some have vacuoles in them where the connective tissue is more evident. This hypertrophy is perhaps a little more marked in the circular muscle fibers. In places, large muscle fibers are present extending from the lining epithelium to the peripheral connective tissue. The entire ureter from the juxtavesical portion to the kidney pelvis has a thin wall, composed of all layers, but the mucous membrane is almost completely obliterated. Here all the tissues stain poorly.

CASE 13 W. K., male, aged 9½ years, admitted March 7, 1930, because of a swelling of the right side of the scrotum. The swelling had been present for 3 weeks and had reached the size of a hen's egg. It ruptured and drained for several days, then healed over, and remained painful and larger than normal. A similar condition had occurred in the left side of the scrotum a year previously and had drained for 4 weeks. The left testicle was removed and a diagnosis of tuberculosis was made. For a month before admission to the hospital he had lost weight and his appetite was poor. Since he was 5 months old he has had a skin affection, first on the buttocks, afterward becoming gradually generalized. The urinary stream was very fine and there was obstruction to urination. Examination revealed an underdeveloped and poorly nourished child. There was a mucoïd discharge from the ears. The teeth were carious and loose. The tonsils were large. The heart and lungs were negative. The bladder was distended as high as the umbilicus. Pus was oozing from the urethral meatus. The left testicle was absent and there was a small healed sinus on the left side of the scrotum. The right testicle was large, hard, and painful. There was an atrophic condition of the skin of the face, and of the extremities and abdomen as far as the umbilicus.

Röntgen-ray examination revealed a sacral spina bifida occulta. An intravenous pyelogram was attempted but was unsuccessful on account of renal insufficiency. Examination of the blood revealed red cells, 3,450,000; white cells, 10,800; hemoglobin, 30 per cent. Examination of the urine showed a small amount of albumin and an excessive amount of pus cells. Tubercle bacilli not noted. Various tuberculin tests were negative. Blood chemistry: non protein nitrogen, 84; uric acid, 8.6; creatinin, 2. An abscess in the right scrotal region was incised the pus of which contained hemolytic streptococci in pure culture. An indwelling catheter was inserted and operation advised, but he ran a septic temperature, and became less clear mentally. Death occurred on April 29, 1930. The clinical diagnosis was chronic urinary retention with renal insufficiency and infection, obstruction of the posterior urethra, acute epididymitis, infantilis, and xeroderma. An autopsy was done April 29, 1930. The anatomical diagnosis was prostatic abscess producing obstruction of the posterior urethra, purulent cystitis, hypertrophy of the bladder wall, bilateral pyonephrosis and pyelonephritis, septicæmia (streptococcus hemolyticus), bronchopneumonia, partial prolapse of the rectum, dwarfism.

Description of the specimen (Fig. 11) The bladder wall is enormously thickened and hypertrophied. There is no evidence of urethral valve formation or strictures. The ureteral openings themselves are normal. On the floor of the prostatic urethra, on the left side, is an opening that measures 2 millimeters in diameter. A smaller opening measuring 3 millimeters is located outside the lining of the mucous membrane of the urethra. A probe inserted in one opening reveals a large cavity in the prostate, and the two previously described openings communicate. The cause for the enormous hypertrophy and thickening of the bladder wall is evidently due to an abscess of the prostate that ruptured into the prostatic urethra, filled up with urine, and caused a chronic obstruction. Examination of the kidneys shows marked hydronephrotic atrophy. Very little kidney tissue remains. The pelvis of the right kidney measures 45 millimeters across, and from the edge of the kidney to the ureteropelvic junction, 60 millimeters. Below this point the ureter is enormously dilated, tortuous, falls on itself and measures 80 millimeters in its largest circumference. As the ureter is followed down it gradually narrows to the juxtavesical portion of the ureter where it is thickened and hard, and stands out in marked contrast to the thick walled dilated portions of the ureter above. The circumference of the ureter here is only 16 millimeters.

The left kidney is 63 millimeters long, 37 millimeters wide, and 20 millimeters thick. The pelvis is much smaller and measures in its widest part 50 millimeters in circumference, and the length down to the ureteropelvic junction is 35 millimeters. The widest part of the left ureteral wall is not as wide as the right wall, its circumference being 90 millimeters.

The ureter is dilated down to its bladder end and as the intramural part is dissected out, the wall of the ureter is thick.

Histology. Serial sections are made of each ureter in the intramural and juxtavesical portions, also of each ureter in its midportion. The changes in each ureter are essentially similar. In the bladder wall and directly above it, the lining epithelium and mucous membrane are thin and are the site of extensive subacute and chronic inflammation. Compressing and partially obliterating the mucous membrane are huge masses of muscle fibers which completely surround the ureter. Here the predominant muscle is circular and all fibers stain well. The hypertrophy of muscle tissue is of the entire juxtavesical portions of the ureters up to the point where dilatation begins.

In the midportion, the ureter wall is thick, this being due largely to chronic inflammatory hyperplasia. Here the muscle fibers are peripherally located and are about normal size in proportion to the thickness of the wall. These portions stain poorly.

CASE 14. A. N., male, aged 12 days, was admitted March 2, 1932. For the first 60 hours following birth no urine was passed. Four days before admission to the hospital the amount of urine passed was very small and the voiding was attended with great difficulty. Vomiting persisted for 4 days. Examination revealed a dehydrated infant with poor tissue turgor. There was a purulent nasal discharge. The tongue dry and heavily coated. There were a few small pustules on the right side of chest. Rhonchi heard in all lung areas. A remnant of the umbilical cord was attached. The bladder was distended up to one fingerbreadth above the navel. Following the catheterization the infant voided frequently small amounts. However a suprapubic tumor rapidly developed. The size of the bladder greatly increased until it reached nearly to the navel. Roentgen-ray examination was negative for stone. An intravenous pyelogram was made—no visualization on the right side. On the left side the urogram showed a hydronephrosis and hydroureter. The cystogram showed an enlarged bladder.

Examination of the blood revealed red cells, 6,500,000; white cells, 4,700; neutrophils, 37 per cent; and lymphocytes, 58. Voided specimens of urine contained albumin, many red blood cells, no casts loaded with white blood cells. Von Pirquet tests were negative. *Staphylococcus aureus* in pure culture were obtained from the blood. On March 17 the infant began to vomit and an impetigo began to spread. The next day the impetigo became much worse, spreading rapidly and appeared as a diffuse progressing superficial inflammation from which the skin exfoliated in sheets without the formation of bullae. Almost the entire body became involved and this was followed quickly by death on March 20. The clinical diagnosis was congenital bladder neck obstruction, left hydronephrosis and hydroureter, exfoliative dermatitis neonatorum (Ritter's disease).

An autopsy was done March 21, 1932. The anatomical diagnosis was congenital iris-diaphragm obstruction of the prostatic portion of the urethra, huge hypertrophy and dilatation of the urinary bladder with diverticulum formation, left hydroureter and hydronephrosis, acute suppurative urethritis, cystitis, and pyelonephritis, (*Staphylococcus aureus* hemolyticus, *Streptococcus hemolyticus*) congenital atresia of the right ureter, aplasia of the right kidney, uremia, hypostatic bronchopneumonia, dehydration, emaciation, excoriation of the skin of the perineum, dermatitis exfoliativa neonatorum (impetigo), Meckel's diverticulum.

Description of specimen (Fig. 13). The bladder wall is very thick. Near the normal location of the right ureteral orifice is seen the opening of a diverticulum. The right ureter fuses with the diverticulum on the right side. The lower end of the right ureter is closed. Both right ureter and kidney show marked aplasia. The left ureteral orifice is normal. In front of it is seen the opening of another diverticulum. The intramural portion of the ureter is thickened and above the thickening the ureter is dilated and tortuous. There is a marked left hydronephrosis. An iris type of valve formation is noted in the posterior urethra.

Histology. In serial sections of the right ureter which has a blind attachment to a diverticulum of the bladder from its lower portion to the kidney, the lumen is patent. The ureter wall has a normally thick epithelium but all of the remainder of the wall is a loose fibrous reticulum extending to the periphery. In this reticulum are small bundles of longitudinal muscle fibers and solitary fibers of circular muscle. In the kidney there is extensive fibrosis, atrophy of the tubules, and many hyalinized glomeruli. In one place of the cortex, cartilage is present. The wall of the diverticulum of the bladder at the lower end of the right ureter has a flat epithelial lining of low cuboid cells. The mucous membrane adjacent is richly vascular and has changes of subacute inflammation. Here the mucous membrane is thick, occupies about two-thirds of the diverticulum wall, and in the periphery are delicate strands of muscle fibers which stain poorly. In serial sections of the entire lower part of the left ureter throughout the entire portion, compressed by a diverticulum of the bladder on this side, the increase in size of the ureter wall is largely due to a huge hypertrophy of muscle fibers. Here the predominant muscle fibers are circular and are mainly peripheral. In places, three-fourths of the thickness of the wall of the ureter consist of muscle fibers which surround the lumen. At those points where the muscle fibers are less dense the thickness consists of mucous membrane.

In serial sections of the midportion of the left ureter the lining epithelium and mucous membrane are narrow. The muscle fibers are scant, and consist essentially of circular fibers. The wall is thin in comparison with the juxtavesical portion.

CASE 15. W. L., male, aged 6 weeks, admitted July 14, 1932 because of a history of diarrhea, fever

of 24 hours duration, and anorexia for 2 weeks. He had been a feeding problem since birth. Examination revealed a markedly anæmic, dehydrated, emaciated, and cyanotic infant, with rapid and shallow respirations. The head was oddly shaped the parietal and occipital bones bulging. The fontanels and cranial sutures were widely separated and here the soft tissues were depressed. The abdomen was distended, tight and bulging at the flanks. There were physical findings of a diffuse bronchopneumonia.

Examination of the blood showed red cells 2,250,000, white cells, 51,400 hæmoglobin 60 per cent polymorphonuclears, 65 per cent large lymphocytes 32 per cent mononuclears, 3 per cent. No urine was obtained, although a test tube was fastened to the penis. The spinal fluid was under normal pressure, 7 cells per cubic millimeter, and negative to bacteriological culture and Wassermann and Kahn reactions. There was occult blood in the stools. Death occurred 31 hours after admission. The clinical diagnosis was intestinal intoxication bronchopneumonia decomposition Mongolism. An autopsy was done July 16 1932. The anatomical diagnosis was congenital membranous valve obstruction of the prostatic portion of the urethra hypertrophy and dilatation of the urinary bladder hydroureter and hydronephrosis marked compression atrophy of the kidney substance, extensive fibrinopurulent cystitis urethritis, and pyelonephritis (*Bacillus coli communis*), acute hyperæmia of the nasopharynx extensive bilateral bronchopneumonia, hyperplasia of the peribronchial lymph nodes and of the conglomerate lymphoid tissue of the lining of the ileum hyperplasia of the mesenteric lymph nodes paralytic ileus generalised anæmia Mongolian idiocy dehydration emaciation widely-separated sutures of the cranial bones phimosia multiple lumbar spinal needle puncture wounds multiple subcutaneous hypodermoclysis needle puncture wounds.

Description of specimen The kidneys ureters, urinary bladder and entire urethra are included in one mass and are carefully dissected. The entire urethra is incised from the glans penis back into the bladder and continued up in front of the bladder to its back portion. The lining of the urethra is normally smooth throughout its entire course, but at the beginning of the prostatic portion of the urethra there is a high linear fold which extends back to the front margin of the verumontanum. In general, this congenital membranous fold of the prostatic urethra is 'V' shaped, the apex of the 'V' pointing toward the verumontanum. The walls of the fold are thin and easily compressible. It is assumed that urine within the bladder would cause an obstruction at the membranous portion of the prostatic urethra by displacing the fold either to the right or left thus making a pocket, and the 'V' shape of the fold would similarly cause difficulty of catheterization from below when the fold was displaced down and laterally by a distended bladder. The fold of the

prostatic portion of the urethra occupies almost the entire caliber of the urethra at this point. The verumontanum is about twice its usual size, and the urinary bladder wall adjacent is thickened, as is that of the body of the urinary bladder generally. The lining of the urinary bladder is coarsely trabeculated. The intramural portions of each ureter are narrow, and directly above the bladder each ureter uniformly for a distance of 20 millimeters is markedly contracted into a narrow firm tube. The right ureter in this juxtavesical portion is cord like. Both ureters, 20 millimeters above the bladder are markedly and uniformly dilated and slightly sacculated throughout their entire length. The pelves of both kidneys are dilated so that they are at least 3 to 4 times the usual size. Hydronephrosis is more marked on the left side. In surfaces made by cutting the kidneys there is hydronephrotic atrophy so that the cortex is in most places only 5 to 7 millimeters thick. At least one third of the kidney substance has been destroyed. The content of the kidney pelves ureters and bladder consists of purulent urine.

Histology In serial sections of the entire lower one-third of each ureter from the intramural portions upward the changes of each ureter are essentially identical. Within the bladder wall, the epithelial lining is narrow the connective tissue of the mucous membrane is normally thick and homogeneous. Here longitudinal muscle bundles are present and some of them have changes of atrophy. Circular muscle fibers are scant. In the peripheral portions of the ureter here, the longitudinal muscle fibers are huge and extend laterally to blend with those of the bladder wall. Adjacent to the bladder wall, and for 20 millimeters upward, the mucous membrane becomes narrow and within it and peripherally to it, the longitudinal fibers are so abundant as to occupy about three fourths of the thickness of the wall. Strands of circular muscle fibers ramify around these longitudinal bundles. Above this juxtavesical portion, the epithelium is more abundant, the mucous membrane connective tissue is less compact and as the ureter is traced upward, the narrow, densely muscular juxtavesical portion gradually dilates. Here the circular muscle fibers are the predominant muscle. At about the middle third of the ureter and up to the kidney the wall is thin. This atrophy is of all layers but especially of the mucous membrane. From the bladder upward to the kidneys on both sides there is subacute inflammation which is present throughout the ureter but especially in the mucous membrane.

In reviewing this series of cases we note that 12 patients were males and 3 were females. The youngest child was 1 month and the oldest 10 years, and 9 were under 7 months of age. The clinical diagnoses were exceedingly interesting and showed, in a large majority, that the urological condition was not recognized. This was in part due to

the fact that some of the patients were seen in the pre-urolological days of pediatrics and also due to the fact that some of the patients entered the hospital practically *in extremis* so that a complete study was not possible. On the other hand, it is exceedingly interesting to note the accuracy of the urological diagnosis in the recent cases since the establishment of the urological service, since which time the attention of the general services has been directed to the possibility of these various lesions so that the diagnoses were made before the cases were referred to the urological service.

A detailed summary of the ages, sex, clinical diagnoses with a brief résumé of the autopsy findings is given in Table I.

An analysis of this group shows that the underlying pathology was essentially obstructive in nature and that in most of the cases the obstruction was congenital in origin. In this group were found the presence of congenital valves in the posterior urethra, the presence of median bars, the presence of diverticula with the ureters inserted into the diverticulum.

The presence of obstruction soon leads to urinary stasis and dilatation, and these patients are prone to urinary infections. The infections may follow the onset of an acute infectious process elsewhere in the body as, for example, an acute upper respiratory infection, diarrhoea, or one of the acute infectious diseases such as measles or infection may follow the passage of sounds, catheters and cystoscopes.

HISTOLOGY

Histological studies were carried out to coronal serial sections of the entire intramural and juxtavesical portions of the ureter as well as all other parts of the ureter that showed gross abnormality. Hemotoxylin and eosin, Van Gieson, and Weigert stains were used.

As a result of these studies, we found that the obstruction in the vesical end of the ureter in 12 cases was due predominantly to hypertrophy of muscle most of which was of the longitudinal fibers. For purposes of comparison a series of normal ureters was re-

moved at autopsy and similar serial sections were made.

In 3 of the cases instead of muscle hypertrophy the lower ends of the ureter showed changes compatible with fibrous or true stricture. In this group there was a predominance of scar tissue which replaced the normal muscle to a very large degree so that we had no difficulty in differentiating between these two types of lesions. In these cases of true fibrous stricture we found an anomalous insertion of the ureter in 3 cases in 1 a double kidney one ureter terminating in the vagina in 2 cases the ureter terminated in a diverticulum in 1 the end of the ureter that was inserted in the diverticulum was completely closed by scar formation.

In seeking an explanation for the presence of the hydronephrosis we found that these cases fall into 3 groups.

1 In the first group the hydronephroses were due to the presence of a true fibrous stricture of the ureter and here we note the presence of an anomalous insertion of the ureter in the 3 cases. In 1 case the accessory ureter with fibrous stricture was inserted in the vagina. In the 2 remaining cases the ureter terminated in a diverticulum.

2 In 11 cases of hydronephrosis the obstruction in the ureter was due to extensive hypertrophy of the muscular coat of the ureter and this involved chiefly the longitudinal fibers. It is exceedingly interesting to note that this hypertrophy was associated with obstructive lesions at or in front of the vesical orifice, such as median bars (3 cases) the presence of congenital valves in the urethra (6 cases) and in 1 case, due to an abscess in the prostate that produced obstruction to urination (Case 13). It would appear, therefore that the muscular hypertrophy was directly associated with the presence of the obstruction. The explanation for the hypertrophy can be readily explained on an anatomical basis.

In 1812 Sir Charles Bell called attention to the fact that some of the muscle bundles of the ureter descend from the orifices of the ureter toward the orifice of the bladder. Here the fibers from each side unite and run toward the prostate. The longitudinal fibers

TABLE I.—SUMMARY OF CASES REPORTED

| Case No. Sex | Age | Clinical diagnosis | Urological condition | Cause of death | Autopsy findings |
|--------------|------------|---|----------------------|--|---|
| 1 M | 1 mo. | Pyeloc obstruction | Not recognized | Broncho-pneumonia | Congenital valve in posterior urethra, hypertrophy and dilatation of urinary bladder; hydroureter and hydrocephalus, bilateral |
| 2 M | 1 yr | Spina bifida, fractured femur talipes equinovarus | Not recognized | Broncho-pneumonia | Spina bifida; horseshoe-shaped kidney; hydroureters and hydrocephalus |
| 3 M | 1 mo. | Alimentary intoxication | Not recognized | Alimentary intoxication | Ectopic right kidney; hydroureter and hydrocephalus, diverticulum of bladder left, constipation and anemia |
| 4 M | 4 yrs. | Acute pyelocystitis | Not recognized | Septicemia | Congenital valve in posterior urethra median bar; hypertrophy of bladder wall; chronic cystitis; bilateral hydrocephalus, dilatation of ureters, multiple abscesses of kidneys |
| 5 F | 5 1/2 mos. | Enstrophy of bladder; acute pyelonephritis | Not recognized | Broncho-pneumonia | Enstrophy of bladder; subacute cystitis and urethritis; empyema; ventral hernia |
| 6 F | 8 1/4 yrs. | Uremia; pyelonephritis postdiabetic | Not recognized | Uremia | Bilateral hydroureters; chronic cystitis; chronic diffuse nephritis, caseous wall; chronic cystitis; bilateral hydrocephalus, dilatation of ureters, multiple abscesses of kidneys |
| 7 M | 6 1/2 mos. | Bronchopneumonia; extreme atrophy | Not recognized | Bronchopneumonia, extreme atrophy | Ectopic right kidney; congenital stenosis of left ureter; hydroureter and hydrocephalus |
| 8 F | 1 1/2 mos. | Gastro-enteritis | Not recognized | Gastro-enteritis | Ectopic right ureter ending in vagina; bilateral duplication of kidney pelves and ureters, pro-ureter and pyonephrosis of upper half of double right kidney |
| 9 M | 1 1/2 yrs | Congenital anomaly of urinary tract—probably vesical neck obstruction or valve—with hydroureters and uremia | Recognized | Uremia | Congenital valve of posterior urethra, median bar; dilatation and hypertrophy of bladder; diverticulum of bladder; bilateral hydroureter and hydrocephalus |
| 10 M | 3 mos. | Vesical neck obstruction with hydroureter and hydrocephalus | Recognized | Broncho-pneumonia | Congenital iris valve of posterior urethra, bladder diverticulum, bilateral hydrocephalus, atrophy of left kidney; bilateral pyelonephritis; hypostatic bronchopneumonia |
| 11 M | 3 mos. | Bronchopneumonia, meningitis | Not recognized | Bronchopneumonia; meningitis (B. influenzae) | Median bar formation, bilateral hydrocephalus, fibropurulent cerebrosplenic leptomeningitis, cavernous sinus thrombophlebitis; bilateral paravertebral abscess, bilateral bronchopneumonia; fibrinopurulent right pleuritis; acute peritonitis |
| 12 M | 6 wks. | Pyelocystitis, pulmonary edema | Not recognized | Broncho-pneumonia | Marked bilateral hydroureters and hydrocephalus with infection; extensive bilateral bronchopneumonia; constipation, dehydration |
| 13 M | 7 wks. | Obstruction of posterior urethra; chronic urinary retention with renal insufficiency and infection | Recognized | Septicemia | Prostatic abscess producing obstruction of posterior urethra, paravertebral cystitis; hypertrophy of bladder wall, bilateral pyelonephritis and pyelocystitis; septicemia (streptococcus hemolyticus); bronchopneumonia, partial prolapse of the rectum |
| 14 M | 14 days | Congenital bladder neck obstruction; left hydrocephalus and hydroureter; cribrate dermalitis | Recognized | Septicemia | Congenital iris-diaphragm of prostatic urethra; hypertrophy and dilatation of urinary bladder with diverticulum formation; left hydroureter and hydrocephalus; acute suppurative urethritis and pyelonephritis, congenital atresia of right ureter; aplasia of right kidney |
| 15 M | 2 mos. | Intestinal intoxication; bronchopneumonia | Not recognized | Broncho-pneumonia | Congenital valve of prostatic urethra; marked hydroureter and hydrocephalus, fibrinopurulent cystitis; urethritis and pyelonephritis, bilateral bronchopneumonia; paralytic ileus |

are also known as Bell's muscles. Some of the ureteral fibers pass medially to form the interureteric ligament or Mercier's bar. These findings were verified by Ellis in 1858.

As is well known, in certain obstructions, for example in benign hypertrophy of the prostate, it is not uncommon to find hypertrophy of the trigone. Wesson has recently studied the musculature of the trigone.

According to his studies, the trigonal muscle is a definite entity arising from the longitudinal muscle bundles of the ureters and is superimposed on the muscles of the bladder wall. Wesson furthermore stated that in his opinion the trigonal muscle plays an active part in the process of micturition, as it pulls open mechanically the internal vesical orifice.

TABLE I.—EFFECT OF VOLUME ON SPREAD OF DYE IN CADAVERS HORIZONTAL POSITION

| No. | C cm injected | Site of injection | Pressure of spinal fluid (cm. water) | Upper level of stain |
|-----|---------------|-------------------|--------------------------------------|----------------------|
| 1 | | L | 8 | T |
| 7 | | -4 L | 4 | 8 T |
| | | -9 L | 20 | 9 T |
| | 3 | -9 L | 10 | 8 T |
| 3 | 3 | -9 L | 6 | 7 T |
| 6 | 4 | L | 3 | T |
| | 4 | -4 L | 4 | 7 T |
| | 6 | -9 L | | T |
| | 6 | -4 L | | 3 T |
| | 8 | L | 20 | Brain stem |

effect of spinal anesthesia upon intestinal tone and motility with special reference to the mechanisms involved and the clinical applications. The methods of study included injection of cadavers, clinical observations, and animal experimentation.

DISTRIBUTION OF ANÆSTHESIA

Cadaver experiments. Method In order to simulate living conditions within the subarachnoid space as nearly as possible it was first filled through a lumbar puncture needle with normal saline solution until the pressure as recorded on a water manometer registered somewhere between 13 and 130 millimeters of water. A dye (Loeffler's methylene blue) was then injected through the same needle and the brain and cord were later exposed to determine its distribution. The conditions of the experiments were varied as to the site of injection (first second, or third lumbar interspaces) the volume injected (1 2 4 6 or 8 cubic centimeters) whether the solution was reinjected or not and the position on the table (horizontal, head raised head lowered before injection, or head lowered after injection) only one factor being varied at a time.

In a series of 38 cadavers, many individual variations as to these points were found but the following generalizations can be made. The upward spread of the dye was directly proportional to the volume injected (Table I). Aspiration and reinjection were equivalent to injection of a larger volume without reinjec-

TABLE II.—EFFECT OF POSITION ON SPREAD OF DYE IN CADAVERS

| No. | C cm injected | Site of injection | Pressure of spinal fluid (cm. water) | Upper level of stain | Position |
|-----|---------------|-------------------|--------------------------------------|----------------------|-----------------------------------|
| | | -3 L | | 3 L | Horizontal |
| 11 | | -3 L | 8 | 9 T | Horizontal |
| 3 | | -3 L | | T | Horizontal |
| 13 | | -3 L | 4 | 8 T | Horizontal |
| 14 | | -3 L | 8 | 6 T | Head lowered after injection |
| 18 | | -3 L | | 9 T | Head lowered after injection |
| 3 | | -3 L | 10 | 7 T | Head lowered after injection |
| 20 | | -3 L | 3 | 9 T | Head lowered as* before injection |
| | | -3 L | | 4 T | Head lowered as* before injection |
| 5 | | -3 L | 9 | 6 C | Head lowered as* before injection |
| 4 | | -3 L | 14 | 7 C | Head lowered as* before injection |
| 31 | | -3 L | | 12 T | Head raised |

tion but were not as effective in spread as when the larger volume was injected at one time. The extension upward increased with depression and decreased with elevation of the head of the table, the amount being proportional to the degree of angulation (Table II). Varying the site of injection one or two spinal segments had only slight effect upon the spread the difference usually equalling the distance between the points of injection, and sometimes being more than balanced by other factors (Table III). Variations in the amount of pressure existing within the subarachnoid space within the limits of normal living conditions (13 to 130 millimeters of water) seemed to have little or no effect on the extension of the dye although it is conceivable that excessive pressures might retard and lowered pressures accelerate the diffusion (Tables I, II, and III). These generalizations represent tendencies only for individual variations and exceptions were frequent making it impossible accurately and definitely to foretell the spread in any given case—rather one could but approximate the tendency in relative terms.

Clinical observations. In a series of 155 spinal anesthetics given at the University Hospital, careful checks were made of the

weight of novocain (or neocaine) given, the volume of spinal fluid in which it was dissolved, the site of injection, the position of the patient, the height of anaesthesia (an algæsia), the pulse, the blood pressure (before and several times during the course of the anaesthesia), the reactions and finally the medication (if any) given (Table IV). For the moment we are concerned only with the height of anaesthesia in relation to volume weight (concentration), position of the patient, and site of injection. Stout (1929) has published charts giving definite levels of anaesthesia for certain volumes and concentrations of solution. Our work has shown that, although certain generalizations can be made, any accurate prediction as to the level of anaesthesia under given conditions is impossible. As in the cadaver experiments, the most striking observation was the great variability in individual cases. For instance, in this series injections of 4 cubic centimeters reached anywhere from the tenth thoracic segment to the brain stem, 3 cubic centimeters from the twelfth thoracic to the first cervical, 2 cubic centimeters from the tenth thoracic to the first cervical, and 1 cubic centimeter from the twelfth thoracic to the first cervical segments. Furthermore, the average for each of these volumes was about the same: fifth, fourth, fourth to fifth, and fourth to fifth thoracic segments, respectively. This would indicate that, within a limited variation, the level of anaesthesia was independent of volume in spite of the mechanical mixing. However when one used enormous volumes (6 to 8 cubic centimeters or more) or if one reinjected several times, noticeable increase in anaesthesia level resulted (Table IV).

If the level of anaesthesia is now checked against the weight of novocain used, marked individual variations are again seen. For instance, 300 milligrams reached anywhere from the seventh thoracic segment to the brain stem, 200 milligrams from the tenth thoracic to the brain stem, and 150 milligrams from the twelfth thoracic to the eighth cervical segments. However here the averages were much more distinctive: that for 300 milligrams being seventh to eighth cervical for 200 milligrams fourth thoracic, and for 150 milligrams fifth to sixth thoracic segments. Again, the

TABLE III—EFFECT OF SITE OF INJECTION ON SPREAD OF DYE IN CADAVERS

| No. | C. cm. injected | Site of injection | Pressure of spinal fluid (cm. water) | Upper level of stain | Position |
|-----|-----------------|-------------------|--------------------------------------|----------------------|--------------|
| 37 | 2 | L | 6 | 6 T | Head lowered |
| 39 | | 2-3 L | | 9 T | Head lowered |
| 35 | 2 | 2-4 L | 8 | 8 T | Head lowered |
| 33 | 2 | 1-2 L | 6 | 8 T | Horizontal |
| 34 | 2 | 2-3 L | 8 | 9 T | Horizontal |
| 27 | 2 | 2-4 L | | L | Horizontal |
| 28 | 2 | 2-4 L | | 12 T | Horizontal |

average weight of novocain for each of the common volumes used (4, 3, 2, and 1 cubic centimeters) was about the same (190, 175, 192, and 190 milligrams, respectively). This would indicate that the level of anaesthesia was proportional to the concentration of solution as long as the volume was within the range of 1 to 4 cubic centimeters. To put it another way, although the level of anaesthesia in any given case can not be accurately foretold for any given dosage (volume and weight) one can expect higher levels (cervical or above) by means of greater mechanical mixing (volumes over 4 cubic centimeters or reinjection of smaller volumes) or by higher concentration of solutions (300 milligrams or more) or by both, whereas dosages of 150 to 200 milligrams dissolved in 1 to 4 cubic centimeters of spinal fluid may be expected to reach to the mid thoracic region, although individual cases may go considerably higher or lower. This tendency of moderate dosages to remain below the mid dorsal region, we believe to be a definite safety factor as we shall attempt to bring out later.

Effect of position on the level of anaesthesia. In most of our clinical cases the head was lowered after injection in some before injection, and in a few it was raised after injection. Taking into consideration the wide variations in levels independent of position, there is still evidence to corroborate the conclusions arrived at in our cadaver experiments that the upper level of anaesthesia is increased by lowering (more so before injection) and decreased by raising the head of the table (Table IV). If one desires to limit the spread of anaesthesia after injection,

It is best to maintain the horizontal position for 5 or 10 minutes after which the anesthetic solution is presumably fixed by the nervous tissue and little or no additional spread takes place. The head may then be lowered to overcome the effects of any fall in blood pressure.

Relation of the site of injection to the level of anesthesia. Most of our clinical cases were injected in the first, second, or third lumbar interspaces. Within these limits no definite effect upon anesthesia level was noticeable or if there were any it was so slight as to be overshadowed by the greater individual variations noted in these cases. However greater variations in the position of the injection (such as mid dorsal) would no doubt show definite differences in anesthesia level, the amount depending upon the height of injection. These findings are again in accord with those noted in our cadaver experiments.

Distribution of anesthetic solution in laboratory animal experiments. In order to determine the course taken by an anesthetic solution injected subarachnoidally a series of experiments was made, cats, rats, dogs and rabbits being used. In all 18 cats, 15 rats, 2 dogs, and 19 rabbits were used. At first an attempt was made to inject through the unbroken skin but, due to the uncertainty of this method it was replaced by laminectomy and subsequent injection under direct vision. Two per cent novocain solution, colored with methylene blue so that the distribution could be determined postmortem, was injected in various volumes. Following are a few of the typical protocols.

Cat 11. Ether anesthesia was administered only sufficient to allow laminectomy in the upper lumbar region. One half cubic centimeter novocain methylene blue solution was injected subarachnoidally at 9:45 a.m. Analgesia was effected to upper cervical region at 9:50 a.m. Another half cubic centimeter was injected at 9:55 a.m. Animal died one half minute later, respiration ceasing first and then the heart gradually failing. At postmortem examination a blue stain was noted around the entire cord and spinal nerve roots, on all of ventral surface of medulla but only on the inferior half of the dorsal surface (in *claterna magna*) on the entire ventral surface of the brain stem covering all the cranial nerves as far as the olfactory nerve. Section of cord, medulla, brain stem, and spinal nerve roots at various levels showed no penetration of color into the substance of the nervous tissue.

Rat 1. Ether anesthesia was administered to allow laminectomy in the upper lumbar region. Injection of 1 cubic centimeter of novocain methylene blue solution was done subarachnoidally. Sudden respiratory death occurred during injection. At postmortem examination a blue color was noted around the entire cord, all spinal nerve roots, the entire brain, and all the cranial nerves. Sections failed to show color within nervous substance.

These experiments showed the usual course of the solution as extending upward around the cord and nerve roots then around the medulla following first along the ventral surface of the medulla and brain stem surrounding the cranial nerve roots and to a lesser extent along the dorsum of the medulla. With increasing volume, the dorsum of the upper medulla, cerebellum, and cerebral cortex were finally reached in the order named. If the extension of the color were an indication of the extension of the novocain itself the failure of the blue to penetrate the nervous substance was not in accord with the production of anesthesia and with the death of the animal. That the novocain penetrated further into the nervous tissues than the dye with which it was in solution was the inevitable conclusion. To obtain direct evidence of this as well as to determine the exact distribution within the nervous tissues, a method of recognizing novocain within the substance of the latter was sought. This was accomplished with the aid of Dr. Meyer Beber of the department of Biochemistry at the University of Nebraska, College of Medicine. A brief description of the method follows.

Diazo color reaction for novocain within the tissues. Two per cent novocain solution (un-colored) is injected subarachnoidally in the experimental work. At autopsy the brain and cord with as much of the cranial and spinal nerve roots as possible are removed and placed into a beaker of cold 5 per cent sodium nitrite solution. After a few minutes hydrochloric acid (one-tenth dilute) is added in the proportion of one of the latter to five of the former solution. This liberates nitrous acid which in turn diazotizes the novocain. It is essential that the solution be kept cold for this reaction. After 5 minutes, the specimens are washed in distilled water and transferred to a 5 per cent alcoholic solution of beta naphthol. The tissue

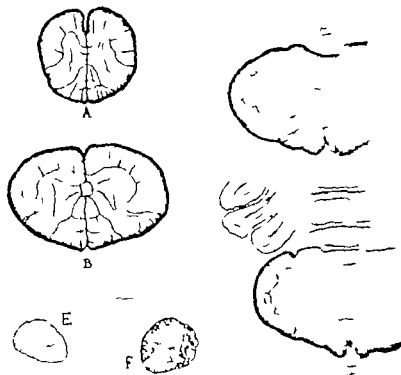


Fig. 1. Drawings of transverse sections of cord, medulla, and nerve roots showing penetration of novocain solution into nervous tissue color reaction. A Thoracic cord (X8), B cervical cord (X8), C medulla (X8), D open portion of medulla, a little higher (X8), E nerve root (X32), F nerve root showing Diase reaction (X32).

containing novocain takes on an orange red color which is greatly intensified by transferring to a weak solution (2 per cent) of sodium hydroxide. The color fades if placed in water or carried through the usual solutions used in preparing paraffin sections. For section work it was found best after bringing out the color reaction to fix the tissue in 10 to 20 per cent formalin for 15 to 20 minutes, freeze, and cut thick (50 μ). Control experiments, in which either distilled water was injected into the subarachnoid space or no injection made at all, failed to produce a similar color reaction when subjected to the same process. The following protocols are typical of those experiments in which this method was used.

Rat 3. Ether anesthesia was given only sufficient to allow laminectomy in the upper lumbar region. One half cubic centimeter of 2 per cent novocain solution was injected into the subarachnoid space. Sudden cessation of respiration was followed shortly by death during last part of injection. The brain, cord, and nerve roots were removed and tested for novocain by the method described above. Grossly the typical orange red color covered the entire cord, all the spinal nerve roots, the entire brain including even the dorsum of the medulla, cerebellum, and

cerebral cortex. In sections above the level of the cord and below the level of the medulla (approximately 1 cm. apart) the color was completely throughout (c, f).

The open portion of the respiratory tract (located) was taken. The uppermost portion was not stained, being a sharp line (pia) separating the arachnoid space from the spinal fluid in which the novocain was penetrating. The color reaction was invisible.

Rat 11. The 1.5 centimeter of 2 per cent novocain solution was injected into the subarachnoid space. The animal died suddenly at the cessation of respiration. The nerve roots showed a heavy orange red color reaction. The ventral surface of the cranial nerve roots and the medulla and cerebellum were penetrated. Rat 3.

TABLE IV—CLINICAL CASES

| Patient and operation | Mgm. Resection | Vol. cm. | Position of patient | Aortic arch level | Pulse | Blood pressure |
|-----------------------|----------------|----------|---------------------|-------------------|-------------|--------------------------------------|
| Salpingectomy | 30 | 4 | 1 b | T | | 130/70-6/70-82/65-100/70 |
| a. Appendectomy | 30 | 4 | 1 | 3 T | 84-70-70 | 100/70-90/60-95/60-100/90 |
| 3 Appendectomy | 30 | 4 | 1 | T | 142 70-90 | 12 70-100/60-90/60 |
| 4 Appendectomy | 30 | 4-R | 1 | 4 T | | 80/70 |
| 5 Appendectomy | 30 | 4 | 1 | 30 T | | |
| 6 Appendectomy | 30 | 3 | 1 a. | T | 15-115 | 14-80/55 |
| 7 Pericystectomy | 30 | 4 | 1 | 3 T | 2-70-90 | 90/70-70/50-100/80 |
| 8. Hysterectomy | 30 | 5 | 1 | 10 T | 80-80 | 10/80 140/80-100/70 |
| 9 Appendectomy | 30 | 5 | 1 | 7 T | 80-90-80 | 70/80-100/80-110/70 |
| 10 Appendectomy | 30 | | 1 | T | 82-100-80 | 14/70-100/80-110/70 |
| Pelvic sepsis | 30 | 5 | 1 | T | 80-70-90-80 | 70-80/50-60/60 |
| Hemorrhoidectomy | 30 | 4 | 1 a. | 5 T | 80-70-80 | 100/90-6/70-90/70 |
| 3 Cholecystectomy | 30 | 4 | 1 a. | 30 T | 0-60 | 15/75 7/75 |
| 12 Hysterectomy | 30 | 4 | 1 a. | 3 T | 80-90-70 | 90/80-100/70-75/50 |
| 5 Hysterectomy | 30 | 0.5 | 1 a. | T | 90-70-70 | 130/70-90/60-90/60 |
| 16 Appendectomy | 30 | 3 | 1 a. | 6 T | 70-90-80 | 80/70-70/60 |
| 17 Hysterectomy | 30 | 5 | 1 a. | 7 T | 80-70-90-60 | 100/70-130/70-100/60 |
| 18 Ovary-ovaryectomy | 30 | | 1 a. | 7 T | 90-70-60-70 | 80/60-110/80-90/60 |
| 19 Cystectomy | 30 | | 1 a. | 7 T | 90-90-100 | 100/90-100/90-100/90 |
| 20 Empyema | 30 | 2.5 | 1 a. | 4 T | 80-70-70 | 80/60-80/60-80/60 |
| 21. Hysterectomy | 30 | 3 | 1 a. | 4 T | 70-75-75 | 100/70-100/60-100/60 |
| 22 Wound sepsis | 30 | 3 | 1 a. | 7 T | 100-110-120 | 110/80-100/80-100/90 |
| 23 Appendectomy | 30 | 3 | 1 a. | T | 65-80 | 5/80-130/90 |
| 24. Hysterectomy | 30 | 3 | 1 a. | 5 T | 80-85 | 130/80-100/70-110/70-100/60 |
| 25. Appendectomy | 30 | 4 | 1 a. | 4 T | 80-100 | 10/80-130/80-90-100/80 |
| 26. Hysterectomy | 30 | 4 | 1 a. | 7 T | 80-100-80 | 130/70-95/60-70/50-70/40-80/30-85/35 |
| 27. Hysterectomy | 30 | | 1 a. | 7 T | 80-60-75 | 130/80-80/70-70-80/60 |
| 28. Appendectomy | 30 | 3 | 1 a. | 7 T | 60-100-11 | 5/70-135/70-5/70 |
| 29. Open reduction | 30 | 3 | 1 a. | T | 70-70-70 | 90/70-130/70-130/70 |
| 30. Appendectomy | 30 | 5 | 1 | T | 115-120-100 | 11/70-11/70-90/70-85/55 |
| Uterinectomy | 30 | 6 | 1 a. | 10 T | 70-75-70 | 5/70-30/80-30/70 |
| 31 Appendectomy | 30 | | 1 | T | 90-100-70 | 10/80-100/70-75/60 |
| 32. Bariatric | 30 | 3 | 1 a. | 3 T | 80-70-60 | 130/80 10/80-10/80 |
| 34. Cystectomy | 30 | 3 | 1 a. | T | 110-100-80 | 5/70-90/80-100/80 |
| 35 Appendectomy | 30 | 3 | 1 | 5 T | 60-60 | 5/70-15/80-115/70 |
| 36. Drainage | 30 | 3 | 1 a. | 9 T | 100 | 100/70-11 |
| 37 Appendectomy | 30 | 5 | 1 a. | 5 T | 70-60-60 | 80/90-100/80-110/70 |
| 38. Appendectomy | 30 | | 1 b | 9 T | 100-90 | 10/80-10/70 |
| 39. Appendectomy | 30 | 3 | 1 a. | C | 90-100-90 | 130/80-115/80 |
| 40. | 30 | 3.5 | 1 a. | 8 T | 70-80 | 80/50-100/70 |
| 41. | 30 | 3 | 1 a. | T | 80-100 | 10/80-10/80 |
| 42. | 30 | | 1 b. | 7 T | 80-80 | 110/70-90/80 |
| 43. Cystectomy | 150 | 4 | 1 a. | 7 T | 100-100 | 120/80-120/70 |
| 44. Cystectomy | 150 | 3.5 | 1 a. | 6 T | 100-100 | 120/100-120/70 |

TABLE IV—CLINICAL CASES—Continued

| Patient and operation | Mgns. per cc. | Vol. ccm. | Position of patient | Anæsthesia level | Pulse | Blood pressure |
|-----------------------|------------------|--------------|------------------------|---------------------|---------------|-----------------------------|
| 41. Appendectomy | 150 | 1 | l.a. | 4 T | 112-96 | 114/70 90/56 |
| 42. Appendectomy | 150 | 4 | l.a. | 3 T | 112-60-76 | 90/60- 00/60 |
| 47. Hemorrhoidectomy | 150 | 4 | l.a. | 10 T | 90-90 | 100/62- 11/78 |
| 48. Appendectomy | 50 | 1 | l.a. | 3 T | 114 100-118 | 118/65-110/60-113/65 |
| 49. Appendectomy | 150 | 1 | l.a. | 1 T | 148-160-108 | 117/58-128/62-130/60 |
| 50. Hysterectomy | 150 | 1 | l.a. | 4 T | 112-106- 14 | 130/80-1 72-94/60-95/58 |
| 51. Appendectomy | 50 | 1 | l.a. | 8 T | 80-112-96 | 100/64-94/60-180/83 |
| 51. Hysterectomy | 150 | 4 | l.a. | 1 T | 100-84 | 108/78-95/60-94/70 |
| 51. Hysterectomy | 150 | 5 | l.a. | 7 T | 118-116 | 118/70- 0/70 |
| 54. Appendectomy | 150 | 1 | l.a. | 9 T | 72-64-64 | 140/80- 40/80 |
| 55. Drainage | 150 | 1 | l.a. | 0 | 0 | 140/80-130/78 |
| 56. Drainage | 150 | | l.a. | 11 T | 80-76 | 140/00-130 78 |
| 57. Appendectomy | 150 | 1.1 | l.a. | 6 T | 64-60 | 118/78-112/84 |
| 58. Appendectomy | 150 | .8 | l.b. | 9 T | 116-112 | 125/65 105/70-120/70 |
| 59. Suspension | 150 | 1 | l.a. | 4 T | 72-108-92 | 140/80-108/64 76/8 |
| 60. Appendectomy | 150 | 2 | l.a. | 3 T | 84 104-72 | 110/65-106/62 |
| 61. Appendectomy | 150 | 2-2 | l.a. | 3 T | 160-100-92 | 110/74-90/62 70/60 |
| 6 Hysterectomy | 150 | 7 | l.a. | 11 T | 118-140- 52 | 152/100-120/40 |
| 63. Pericardiectomy | 150 | 1 | l.b. | 3 T | 160-112 | 114/82-98/65-94/68 |
| 64. Hemorrhoidectomy | 200 | 4 | l.a. | 3 T | 180-70 | 98/60-106/64 |
| 65. Salpingectomy | 200 | .5 | l.a. | 3 T | 108-136-72 | 136/80-78/40-106/60 |
| 66. Hemorrhoidectomy | 200 | 5 | l.a. | 3 T | 126-132-108 | 152/86-114/82-140/8 |
| 67. Cholecystectomy | 200 | 3 | l.a. | 3 T | 60-50-60 | 96/64 78/40-80/50 |
| 68. Appendectomy | 200 | 2 | l.a. | 4 T | 84-72-72 | 120/78-128/80-126/78 |
| 69. Amputation | 200 | 2 | l.a. | 10 T | 80-92-85 | 120/75 1 3/78- 5/75 |
| 70. Pericardiectomy | 200 | | l.a. | 4 T | 80-75-85 | 115/85-130/80 |
| 71. Appendectomy | 200 | 4 | l.a. | 3 T | 60-72-66 | 28/52-120/60-122/78 |
| 72. Appendectomy | 200 | 4 | l.a. | 3 T | 60-66-66 | 118/52-110/60-118/76-122/78 |
| 73. Anal repair | 200 | 4 | l.a. | 3 T | 200-138-72 | 140/78-110/76-94/60-102/68 |
| 74. Pericardiectomy | 200 | 4 | l.a. | 1 T | 100-108-102 | 116/76-124/64 108/52-11 76 |
| 75. Appendectomy | 200 | 1 | l.a. | 7 T | 74-80-76 | 122/78-138/64 118/68 |
| 76. Pericardiectomy | 200 | | l.a. | 4 T | 98-82-96 | 140/90-145/95-142/100 |
| 77. Cholecystectomy | 200 | | l.a. | 7 T | 84-140-128-92 | 130/90-112/76-126/76 |
| 78. Suspension | 200 | 2 | l.a. | 4 T | 84-70-80 | 102/74-100/66-1 70 |
| 79. Hysterectomy | 200 | 2 5 | l.a. | 7 T | 92-84-68-60 | 92/60-86/64-84/64 |
| 80. Hysterectomy | 200 | 2 | l.a. | 3 T | 122-96-100 | 124/80-122/72-128/58 |
| 81. | 200 | 4 | l.a. | 7 T | 76- 00-100 | 120/85 150/90-140/82 |
| 81. Appendectomy | 200 | 4 | l.a. | 4 T | 70-70 | 120/70-124/90-130/90 |
| 81. Appendectomy | 200 | 4 | l.a. | 7 T | 72-85-85 | 114/84-100/60-130/80 |
| 81. Salpingectomy | 200 | 4 | l.a. | 7 T | 86-100-85 | 120/56-114/60-120/60 |
| 81. Appendectomy | 200 | 4 | l.a. | 8 T | 12-108-104 | 110/80-108/78-100/80 |
| 84. Hemorrhoidectomy | 200 | 4 | l.a. | 10 T | 60-82-56 | 90/60-108/60-96/60 |
| 87. Appendectomy | 200 | 3 | l.a. | 4 T | 82-72-63 | 130/76-126/82-136/74 |
| 88. Cholecystectomy | 200 | 4 | l.a. | 4 T | 97-90-60-100 | 160/90-180/60-200/70-130/70 |

TABLE IV—CLINICAL CASES—Continued

| Patient and operation | Mgm. necrotum | Vol. cm | Position of patient | Anaesthesia level | Pulse | Blood pressure |
|-----------------------|---------------|---------|---------------------|-------------------|---------------|------------------------------|
| 80. Hemorrhaphy | 300 | 4 | l.a. | 4 T | 70-80-120 | 140/80-70/50-120/80 |
| 90. Appendectomy | 300 | 3 | l.a. | 4 T | 60-120-100 | 100/70-85/50-50/50 |
| 91. Appendectomy | 300 | 3 | l.a. | 4 T | 72-90-90 | 60/70-84/50-115/70 |
| 92. Appendectomy | 300 | 3 | l | 4 T | 80-90 | 70/90-145/100 |
| 93. Salpingectomy | 300 | 3 | l.a. | T | 70-90-65 | 85/80-80/70-105/70 |
| 94. Hemorrhaphy | 300 | 4 | l.a. | 8 T | 60-90-80 | 150/80-90/80-130/80-110/80 |
| 95. Appendectomy | 300 | 4 | l.a. | 4 T | 80-90-80 | 175/130/80-130/50 |
| 96. Salpingectomy | 300 | 4 | l.a. | 10 T | 90-100-120-90 | 70/75-80/80-100/80-100/70 |
| 97. Skin graft | 300 | 4 | l.a. | T | 80-70-60 | 140/90-170/90-120/80 |
| 98. Salpingectomy | 300 | 3 | l.a. | C | 70-90-70 | 105/70-140/90-15/80 |
| 99. Oostomy | 300 | 4 | l.a. | 3 T | 60-60-60 | 100/80-95/80-80/50 |
| 100. Exploratory | 300 | 4 | l.a. | T | 80-84-85 | 140/80-80/70-95/70 |
| 101. Sarcocoma | 300 | 1 | l | 3 T | 60-84-75 | 90/80-900/70-95/64 |
| 102. Cholecystectomy | 300 | 1 | l | T | 90-80 | 70/80-76/— |
| 103. Hysterectomy | 300 | 1 | l | 3 T | 140-75-100 | 160/115-84/75-90/75 |
| 104. Cholecystectomy | 300 | 3.5 | l | T | 90-100-80 | 114/76-140/70-125/70 |
| 105. Appendectomy | 300 | 1 | l.a. | T | 80-70 | 90/85-120/75-100/75 |
| 106. Hysterectomy | 300 | 4 | l.a. | C | 90-85 | 144/90-100/87-100/70-10/76 |
| 107. Prostatectomy | 300 | 4 | l | 3 T | 90-76-76 | 144/84-74/76-60/—8/76 |
| 108. Hemorrhaphy | 300 | 4.5 | l | T | 80-75-125 | 124/70-90/80-94/80-90/80 |
| 109. Hemorrhaphy | 300 | 1 | l | 4 T | 80-100 | 60/85-100/75 |
| 110. Salpingectomy | 300 | 1 | l.a. | T | 120-95-85 | 100/115-70/80-85/115-90/80 |
| 111. Hysterectomy | 300 | 1 | l.a. | 4 T | 85-90-800 | 140/80-80/70-90/70-130/80 |
| 112. Appendectomy | 300 | 1 | l | 6 T | 90-900-90 | 140/100-100/85-10/84 |
| 113. Sarcocoma | 300 | 1 | l.a. | 30 T | 84-90-80 | 97/115-104/80-90/80-700/80 |
| 114. Hysterectomy | 300 | 8 | l | 4 T | 70-100-90 | 90/80-75/115-130/90 |
| 115. Hemorrhaphy | 300 | 1 | l.a. | T | 60-80-70 | 11/90-15/76-115-115/80 |
| 116. Cholecystectomy | 300 | 1 | l.a. | 7 T | 75-115-65 | 100/80-75/80-76/80 |
| 117. Cholecystectomy | 300 | 1 | l.a. | 30 T | 120-90-100 | 90/70-95/70-90/15 |
| 118. Hemorrhaphy | 300 | 1 | l.a. | 4 T | 120-15-6-80 | 11/85-10/80 |
| 119. Salpingectomy | 300 | 1.4 | l.a. | 8 T | 115-120-90-4 | 100/70-80/115-90/80 |
| 120. Salpingectomy | 300 | 1 | l.a. | 3 T | 120-90 | 70-100/70-10/76 |
| 121. Drainage | 300 | 1.4 | l.a. | T | 100-120-95 | 100/80-60/100-10/15 |
| 122. Carcinoma | 300 | 1 | l.a. | T | 80-84 | 80/90-85/5 |
| 123. Salpingectomy | 300 | 1 | l.a. | 30 T | 120-90-85 | 100/80-120/90-100/80 |
| 124. Appendectomy | 300 | 1 | l | 3 T | 80-130-124 | 11/76-115/80-11/74 |
| 125. Appendectomy | 300 | 6 | l.a. | 7 T | 100-100 | 100/80-90/84 |
| 126. Cholecystectomy | 300 | 1 | l | T | 90-76 | 160/100-84/80 |
| 127. Hemorrhaphy | 300 | 4 | l | Brake stand | 84-115-90 | 100/84-120/100-95/70-110/90 |
| 128. Hemorrhaphy | 300 | 4 | l.a. | 6 T | 80-70-80 | 145/90-90/70-115/70 |
| 129. RfO reaction | 130 | 8 | l | Brake stand | 80-64-66 | 76/80-70/80-60/45/14 |
| 130. Perforated ulcer | 300 | 3 | l.a. | 4 T | 5-10-130 | 120/75-95/85-100/80 |
| 131. Interposition | 300 | 1 | l.a. | C | 80-70 | 160/90-80/70-115/40-40/— |
| 132. Salpingectomy | 300 | 1 | l.a. | T | 80-90-900 | 110/70-90/80-100/130-115/100 |

TABLE IV—CLINICAL CASES—Continued

| Patient and operation | Mgm. novocain | Vol. c.c.m. | Position of patient | Anesthetic level | Pulse | Blood pressure |
|-----------------------|---------------|-------------|---------------------|------------------|-------------|------------------------------|
| 131. Hysterectomy | 300 | 15 | L.A. | 1 C | 80-90-80 | 120/90-100/80-85/60-50/50 |
| 132. Appendectomy | 300 | 1 | L.A. | 1 C | 90-60-70 | 120/90-90/80-105/70 |
| 133. Hysterectomy | 300 | 1 | L.A. | 1 C | 70-80-85 | 110/80-70/50-60-80/50-120/80 |
| 134. Hysterectomy | 300 | 4 | L.A. | 4 T | 108-62-92 | 120/90-85/85-70/40-80/60 |
| 135. Salpingectomy | 300 | 1 | L.A. | 4 T | 110-120-120 | 120/80-90/80- 90/80 |
| 136. Hysterectomy | 300 | 1 | L.A. | 1 C | 66-104-92 | 150/80-102/80-1 76-106/72 |
| 137. Hysterectomy | 300 | 1 | L.b. | 3 T | 122-80-112 | 100/85 1 4/75 120/85 |
| 138. Hysterectomy | 300 | 1 | L.A. | 7 T | 5 4-125-125 | 122/80-84/82-125/84 |
| 139. Jaw abscess | 400 | 8 | L.A. | Brain stem | 70-70 | 122/85 3/75-80/50 |
| 140. Ovarian cyst | 400 | 4 | L.A. | 7 T | 91-80-105 | 125/90-100/70-85/62-92/70 |
| 141. Cholecystectomy | 25 | 6 | L.A. | 1 C | 85-98 | 120/78-85/60 |
| 142. Exploration | 25 | 6 | L.A. | Brain stem | 62-68 | 110/80-80/50-80/50 |
| 143. Cesarean section | 225 | 4 | L.A. | T | 126-95-120 | 124/84-90/42- 20 38 |
| 144. Perineorrhaphy | 120 | 6 | L.A. | 7 T | | |
| 145. Hysterectomy | 280 | 4 | L.A. | 1 T | | |
| 146. Salpingectomy | 225 | 4 R | L.A. | 8 T | | |
| 147. Appendectomy | 225 | 6 R | L.A. | 2 T | 74-90 | 11 76-112/6 |
| 148. Appendectomy | 225 | 4 | L.A. | 1 T | 62-90- 95 | 120/80-120/80-124/70 |
| 149. Herniorrhaphy | 225 | 4 | L.A. | 4 T | 68-72-78 | 103/ 00-120/80-120/80 |
| 150. Suspension | 225 | 4 | L.A. | 2 T | 60-100-80 | 106/62-98/56- 10/78 |
| 151. Hysterectomy | 2 2 | 4 | L.A. | 3 T | 84 206-102 | 102/68-108/50-102/50-80/80 |
| 152. Hysterectomy | 225 | 4 | L.A. | 1 T | 86-72-60 | 24/72-98/50- 24/98 |
| 153. Otolaryngology | 100 | 2 | L.A. | 1 T | 125 144 | 1 76- 1/98 |

L.b.—Head lowered before injection. L.A.—Head lowered after injection. L.A.—Head raised after injection.

These experiments show the same general distribution as seen in those in which methyl blue was used as the coloring agent, but in addition indicate that the anæsthesia may be the result either of action upon the nerve roots or upon the sensory tracts within the cord and brain. They also show the possibility of the anæsthetic solution reaching the vital medullary centers if sufficient volume is used.

THE BLOOD PRESSURE IN SPINAL ANÆSTHESIA

The most disconcerting complication of spinal anæsthesia has been the marked fall in blood pressure which so often occurs. The real cause of this fall has been the subject of considerable controversy. Doenitz (1903) and Klapp (1904) thought it due to the absorption of the drug into the circulation. Tuffier and Hallion (1900) thought it due to action on the cord or nerve roots since they noted rise in blood pressure from stimulation of the periph-

eral nerves (splanchnics) after the administration of spinal anæsthesia.

Heineke and Laewen (1906) found with subarachnoid injections of cocaine an immediate, intensive, long lasting fall in blood pressure and frequently immediate death, with intravenous injections an immediate but short fall in blood pressure and only with the largest doses death. Intramuscular injections produced no noticeable changes in blood pressure. They placed a ligature about the upper thoracic cord and found only slight fall in blood pressure following injection below the ligature but intense fall (30 to 50 per cent) and death following injection above the ligature. They concluded that the drop in blood pressure was due to direct action upon nerve centers rather than to absorption of the drug into the circulation. Smith and Porter (1915) thought the drop due to paralysis of the splanchnics, not to paralysis of the bulbar

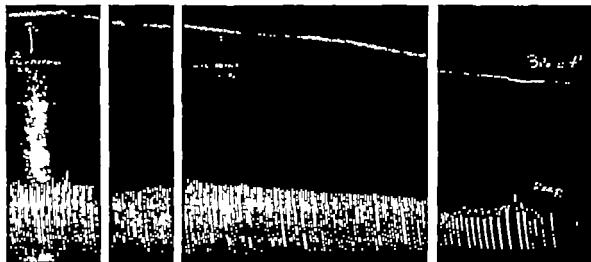


Fig. Tracings showing independence of the fall in blood pressure and changes in costal respirations following subarachnoid injection of novocain solution. Dog.

vasomotor centers, since they found the greatest percentage fall when the anæsthetic was confined to the thoracic as compared to the cervical and lumbar regions.

Schiff and Ziegner (1924) injected subarachnoidally the various regions of the cord isolated by ligatures and found only slight fall in blood pressure with injections of novocain confined to the lumbar region but a much greater fall (still compatible with life) with injections confined to the thoracic region. Injections above the upper thoracic region caused the animal to stop breathing, the blood pressure remaining up for a minute or so and death ensuing unless artificial respiration was instituted. They concluded that the fall was due to action upon the preganglionic fibers of the thoracic region (splanchnics). Ferguson and North (1932) found only slight drop in pressure by sectioning the splanchnics and the usual profound fall by subarachnoid anæsthesia following section. By injection of novocain solution subarachnoidally below a ligature placed at the level of the fifth thoracic segment they found only a moderate decrease in blood pressure (19 per cent) whereas injection above the ligature produced a most intense fall (37 per cent additional or 56 per cent in all). Kremer and Wright (1932) found similar results from sectioning the splanchnics. Bower, Clark, Wagoner and Burns (1932) also

found the greatest fall in blood pressure with injections into the upper thoracic and cervical regions, but explained its occurrence by the interference with respiration and the loss of the sucking action of the chest upon the right side of the heart—the marked fall in blood pressure being then due according to them to myocardial failure instead of vasomotor paralysis. A somewhat similar view was expressed by Seevers and Waters (1932). Cotul and Standard (1932) found direct paralysis of respiratory and vasomotor centers by cisternal injections of small quantities of novocain solution.

Out of this maze of evidence one fact stands forth—the effect on the blood pressure is due to local action upon the nerve roots, cord, or medulla and not to absorption into the circulation since much larger doses than are used in spinal anæsthesia are necessary to produce even slight fall in blood pressure when injected intravenously. Whether this effect is due to paralysis of the vasomotor center in the medulla, or vasomotor fibers within the cord or nerve roots, or whether it is secondary to myocardial weakness resulting from interference with respiratory movements by the action of the anæsthetic on intercostal or phrenic nerves, are questions in which we were particularly interested and have attempted to answer by animal experimentation. A series of

2 dogs and 17 rabbits were used for this purpose. We first wished to test out the theory of the fall in blood pressure being due to cardiac weakness resulting from interference with respiration. The following are a few typical protocols

Dog 1. Ether anaesthesia just sufficient to permit the necessary surgical procedures. The right carotid artery was cannulated and connected with a mercury manometer, the pointer of which was made to record upon a kymographic drum. Costal respirations were also recorded by means of a pneumograph and air tambour. A laminectomy was done in the upper lumbar region thus exposing the dura. With a fine needle and Luer syringe, 2 cubic centimeters of 2 per cent novocain solution colored with methylene blue were injected into the subarachnoid space the needle being pointed cephalad. There was considerable leakage around the needle so that only a part of the solution entered the subarachnoid space. After a short latent period there was a gradual fall in blood pressure, the respirations remaining unchanged. Five minutes later an additional 2 cubic centimeters were injected (again with leakage). This was followed by an additional but still gradual fall in blood pressure, the respirations still remaining about the same. Finally when the blood pressure reached 40 millimeters of mercury, the respiratory movements showed a slowing and decrease in amplitude, and at 20 millimeters stopped completely. Since the fall in blood pressure preceded by a considerable period any change in the respirations. It is difficult to see how the latter could be responsible for the fall noted in this case (Fig. 3).

Rabbit 4. Urethane and morphine anaesthesia. The trachea was cannulated and artificial respiration carried on throughout the experiment. Laminectomy was done in the lower thoracic and upper lumbar regions and 1 cubic centimeter of 2 per cent novocain colored with methylene blue was injected cephalad into the subarachnoid space. There was slight leakage about the needle. The typical fall in blood pressure took place (Fig. 3) in spite of the fact that artificial respiration was carried on, preventing any possible myocardial weakness due to interference with respiration. In fact, Bower, Clark, Wagoner, and Burns (1932) in their own experiments with myocardiographic tracings used artificial respiration and got the usual fall in blood pressure with spinal anaesthesia, making it difficult to see how the fall could be due to respiratory difficulty. In addition, the fall in pressure in their experiments occurred before changes in myocardiographic tracings, indicating independence of etiology.

The results in these experiments make untenable any theory placing the mechanism of blood pressure fall upon a basis of myocardial weakness, resulting from interference with



Fig. 3. The fall in blood pressure following a subarachnoid injection of 1 cubic centimeter of 2 per cent novocain solution in a rabbit under artificial respiration.

respiration. That the latter occurs in spinal anaesthesia, we agree (see below), but only in a concomitant relation to blood pressure fall rather than in one of cause and effect. We also grant that, with complete cessation of respiration, there is an additional sharp drop in blood pressure (after a preliminary anoxemic rise) due to cardiac failure, but this is a terminal phenomenon and not the ordinary fall compatible with safe anaesthesia. Since in the experiments enumerated, there were also no appreciable changes in total blood volume, the usual fall in blood pressure must have been due to reduction in peripheral resistance, which means that the anaesthetic must have affected the vasomotor system. The only parts of the latter system accessible to the anaesthetic solution are the vasomotor center in the medulla or the vasomotor fibers within the cord or nerve roots. That it is possible for a solution to reach the interior of the cord and medulla as well as of the nerve roots has been demonstrated by our diazo test for novocain. In either event, the effect must be upon the medullary center or upon the preganglionic sympathetic fibers. This means that it is still possible after spinal anaesthesia to produce vasoconstriction and rise in blood pressure by stimulation of the postganglionic fibers or myoneural junctions, as with the use of epinephrine or adrenaline. Figure 4 is a record of an experiment demonstrating this latter point experimentally in animals. In our clinical cases are numerous examples of rise in blood pressure when adrenaline was injected following marked fall during the course of spinal anaesthesia (Cases 1, 7, 10, 11, 22, etc., Table IV).



Fig. 4. The effect of an intracardiac injection of one cubic centimeter of 1:1000 solution of adrenaline chloride upon the blood pressure which had fallen to 24 millimeters during spinal anesthesia. Rabbit.

Boehamer (1925) has sectioned the white rami communicantes in the frog and noted dilatation of the peripheral vessels innervated. This is a most difficult procedure in the usual laboratory animals—the difficulties of exposure and recognition making it unfeasible. Instead, we have sought the accessible preganglionic fibers in our rabbit experiments. The animals were anesthetized with urethane which according to Heineke and Laewen (1906) does not affect the respirations, and morphine, and the carotid artery cannulated for blood pressure recording. Artificial respiration was used throughout in some animals, in others only when the respirations became depressed. The sympathetic chains in the neck and the splanchnics in the abdomen both made up largely of preganglionic fibers, were exposed. We tried but abandoned as unsatisfactory the posterior approach for exposure of the splanchnics as described by Ferguson and North (1932). It is almost impossible by such a method to be certain of exposing the proper structures and the procedure possesses no advantage over high abdominal approach. In addition the upper thoracic sympathetic chains were exposed by resecting a part of the chest wall on each side. These chains, of course contained both preganglionic and postganglionic fibers. The effect upon the blood pressure of stimulating and sectioning these was noted as was also the effect of spinal anesthesia, induced after sectioning.

The results (Fig. 5) were quite definite, though sometimes slight or moderate in degree. Stimulation of either preganglionic or postganglionic fibers caused a constriction of the peripheral vessels (ear vessels in case of

cervical sympathetics) and a rise in blood pressure and section of these nerves produced a corresponding dilatation and fall a latent period of variable length first ensuing. After the cervical splanchnic, and upper thoracic chains were sectioned and a spinal anesthetic then given, there occurred an additional, more marked but gradual fall in blood pressure indicating that additional vasoconstrictor fibers were reached by the anesthetic that were not caught in the sections. Whether the action of the novocain be upon the preganglionic vasoconstrictor fibers within the nerve roots or those descending within the cord is immaterial. Since the vasoconstrictor fibers emerge from the first thoracic to the third or fourth lumbar segments of the cord (Starling 1930) it is obvious that the higher the anesthetic reaches in the thoracic region the greater the number of vasoconstrictor fibers thrown out and the greater the resulting fall in blood pressure. The fall in blood pressure was gradual as long as the solution was kept below the medulla. When however but a few drops were injected into the cisterna magna so as to reach the medullary centers, there was a sudden, abrupt fall in blood pressure as well as a sudden cessation of respiration (Fig. 6) due to direct action upon the vital centers.

Until recently it has been held that the greatest dilatation occurred in the splanchnic region. However Ferguson and North (1932) and Bower Clark, Wagoner and Burns (1932) have shown in dogs, by confining the anesthetic solution to certain parts of the cord through the use of ligatures, that only a moderate fall in blood pressure took place when the anesthetic was confined below the fifth thoracic segment (the splanchnics coming off from the fifth to twelfth thoracic) while a much greater fall occurred when the injection was made into the compartment above the fifth thoracic region. This was in harmony with the usual failure to note marked vasodilatation in the splanchnic area during the course of abdominal operations under spinal anesthesia. They concluded that about one-third of the blood pressure change was due to dilatation in the splanchnic area, abdominal wall, and lower extremities, and two-thirds to vasodilatation in the head, neck, upper ex-

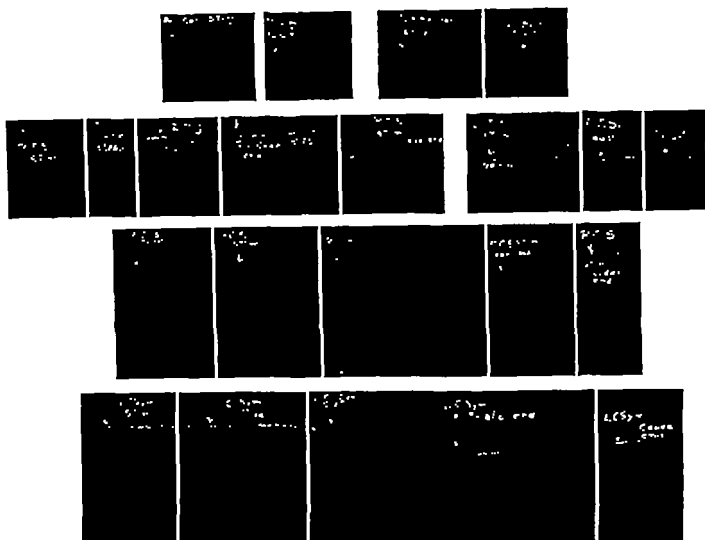


Fig. 5. The effects upon blood pressure of stimulating and cutting the right splanchnic, left splanchnic, right thoracic sympathetic, left thoracic sympathetic, right

cervical sympathetic and left cervical sympathetic chains, in the order shown. The experiments were carried out on a rabbit.

trémities, thorax, and its contents. By checking postmortem the upper level of the stain, mixed with the novocain used in subarachnoid injections, with the blood pressure records during life, we have arrived at approximately the same conclusions from our animal experiments.

Interesting clinical data along the same lines may be obtained from Table IV by checking the blood pressure fall with the height of anesthesia as determined by the pin test. In 55 cases in which the anæsthetic was confined below the fourth thoracic segment, the average fall in systolic pressure was nine points and in pulse pressure six points. The average fall in 70 cases, in which the upper level of anesthesia was between the fourth thoracic and eighth cervical segments, was fifteen in systolic pressure and eighteen in

pulse pressure. In 18 cases in which the anesthesia reached higher than the eighth cervical segment, the average fall in systolic pressure was twenty-seven points and in pulse pressure fourteen points. It must be remembered that as the anæsthetic solution reaches higher in the cord a cumulative action results the nerve roots being anesthetized progressively from below upward and the descending fibers with in the cord being anesthetized so that segments of the cord below are affected. Perhaps the latter accounts for the relatively greater fall in the cervical region even though all vasoconstrictor fibers are given off from the cord below that region. These percentages do not give an exact picture of the amount of blood pressure drop because most of these cases had a preliminary injection of ephedrine which

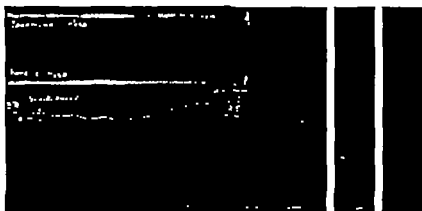


Fig. 6. The effect upon abdominal and thoracic respirations, and blood pressure of a cisternal injection of 0.12 cubic centimeter of a 1 per cent novocain solution (colored with methylene blue). Dye confined to medullary region. Rabbit.

limited the fall. The average fall in systolic blood pressure in the cases not receiving preliminary ephedrine was much higher (26 per cent for those reaching to the eighth cervical segment and 48 per cent for those going above the eighth cervical segment). Whether one agrees upon the exact percentage influence of each region of the cord upon blood pressure one must admit the cumulative action with progression upward and must expect that the higher the anesthesia produced the greater will be the fall in blood pressure.

CHANGES IN PULSE

Table IV also shows the slowing of pulse rate during spinal anesthesia which most observers have reported. However this is true only in those cases in which the anesthesia reached above the fourth thoracic segment, the average decrease in 60 such cases being eight per minute. These figures failed to give a complete idea of the degree of change since the usual increase in pulse rate due to surgical procedures and that due to the action of ephedrine had to be overcome in addition. Similar findings were noted in our animal experiments. The slowing of the pulse is due to paralysis of the preganglionic fibers (white rami communicantes) coming from the first four thoracic segments, since these fibers carry the accelerator impulses to the heart (Kuntz 1929) and their paralysis allows the depressor vagi to act unopposed in slowing the heart.

THE EFFECT UPON RESPIRATION

Another important controversial question has been the effect of spinal anesthesia upon respiration. That the solution in a subarachnoid injection may reach the peripheral nerves of respiration (intercostal and phrenic) the descending respiratory fibers within the cord and medulla, and even the respiratory center itself has already been shown by the dye distribution in our cadaver and animal experiments, and by the cutaneous tests in our clinical cases.

Many observers have noted a selectivity of novocain for sensory nerves the vasomotor nerves being affected next and the somatic motor nerves last of all. Experimental proof of these facts has been offered by Kochs (1886) Santesson (1906) Geeser and Erlanger (1929). However the margin of safety is not definite and probably not very great. The possibility of motor nerves or centers bathed by novocain solution being anesthetized cannot be disregarded in interpreting the phenomena associated with spinal anesthesia.

Animal experimentation. In laboratory animals in which the novocain solution was confined below the lower thoracic region (tenth or eleventh segments) there was very little effect upon the respiration (Fig. 7). When the solution reached higher levels, the intercostal nerves were progressively paralyzed the abdominal movements increasing to compensate for the loss of costal breathing. If

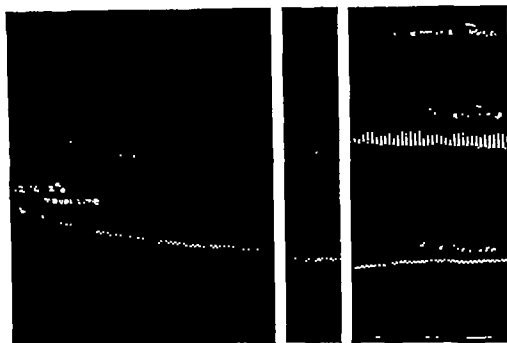


Fig. 7 The effect upon abdominal and thoracic respirations, and blood pressure of a lumbar subarachnoid injection of 0.5 cubic centimeter of a per cent novocain methylene blue solution which reached only to the tenth thoracic segment. Rabbit.

however the solution continued to mount in the subarachnoid space, diaphragmatic breathing was likewise gradually depressed and finally it ceased altogether, the animal dying a few moments later (Fig 8). Similar effects upon the respiration were noted in rats and cats by sectioning the nerve roots. When the thoracic nerve roots of both sides were sectioned the animal continued in good condition but the character of the breathing changed to abdominal. If the cervical roots (three to eight) on both sides were then sectioned abdominal breathing likewise stopped and the animal died. Cutting the cervical roots first (with intact thoracic roots) also caused death of the animals diaphragmatic breathing apparently being essential to life in the cat and rat. Introduction of but a few drops of novocain solution directly into the cisterna magna caused immediate cessation of all breathing and death of the animal from direct action on the medullary centers (Fig 6).

These experiments show that in spite of the supposed selectivity of novocain for sensory and vasomotor nerves, the peripheral motor nerves (phrenic and intercostal) and even the respiratory center are effected by volumes sufficient to reach them and definite changes in respiration result. We have already shown

that the fall in blood pressure is not dependent upon changes in respiration. Likewise the changes in respiration are not primarily dependent upon the fall in blood pressure and resulting anemia of the brain as claimed by Labat, Koster, and others for the character of these changes is definitely related to the progression of novocain from below upward. The changes in blood pressure and respiration are concomitant phenomena due to the action of novocain on all nerve structures which it reaches. That there is an interrelationship between blood pressure and respiration cannot be denied—a marked fall in blood pressure may cause anemia of the brain and secondary effect upon respiration (low position of head is indicated), and complete cessation of respiration does cause a fall in blood pressure after a preliminary rise due to anoxemia, but these are late effects and follow the primary changes due to the action of novocain itself. We are not, therefore, able to agree with Koster and others that novocain may be circulated about the cervical and medullary regions with safety and believe that the greatest safety in spinal anesthesia may be obtained by confining the solution below the midthoracic region and that operations above the diaphragm under spinal anesthesia are dangerous chiefly because



Fig 3. The effect upon abdominal and thoracic respirations, and blood pressure of a lumbar subarachnoid injection of 0.5 cubic centimeter of 2 per cent novocain methylene blue solution which reached to the brain stem. Rabbit.

of the effect of novocain on the respiratory nerves and medullary centers.

Clinical The following clinical case illustrates the dangers of high anesthesia.

Mrs. S. aged 70 years, had an interposition operation for cystocele and uterine prolapse. Spinal anesthesia was obtained by means of 300 milligrams of neocaine dissolved in 1 cubic centimeter spinal fluid and injected into first lumbar interspace. Patient was immediately placed in the dorsal lithotomy position with the head lowered. The blood pressure before injection was 160 systolic and 90 diastolic. Ten minutes after injection it had fallen to 80 systolic and 50 diastolic, but the patient's general condition was good and the respiration quite normal except for the fact that it was more diaphragmatic in character. Pin tests showed that cutaneous anesthesia had reached to the first thoracic segment. Ten minutes later the blood pressure was about the same, 75/45, but the cutaneous anesthesia had reached to the first cervical segment and the respirations were slower and more shallow. Five minutes after this, the respirations suddenly stopped, the patient became cyanotic, and the blood pressure could not be recorded. The pulse was feeble and slow and soon could not be gotten at all. The heart sounds could not be heard. Artificial respiration was immediately instituted. Strychnine sulphate grains 1/30 and alpha-lobelin grains 1/20 were given hypodermically and adrenaline (1:1000 solution) 1 cubic centimeter was injected directly into the heart. Several minutes later the heart sounds could be made out and a feeble pulse could be felt. After about 15 minutes of artificial respiration, the patient took a few spontaneous breaths which gradually increased in rate and depth until her condition was apparently normal again.

A careful study of this case shows the typical progressive effects upon the respiratory mechanism seen in our laboratory experiments—first a change to abdominal breathing to compensate for loss of intercostals, then interference with the abdominal breathing by paralysis of the cervical segments (phrenics) and even possible effect upon the medullary centers (although this would be relatively unimportant since all the peripheral respiratory nerves were already affected). It is to be noted that there was an early drop in blood pressure (50 per cent) but that this was compatible with good respiration (though modified) and good general condition showing the independence of changes in blood pressure and respiration. Furthermore, the blood pressure remained about the same until the respirations ceased entirely when it became imperceptible due to the anoxemia of the medulla or possibly to direct actions of novocain upon the vasoconstrictor as well as respiratory centers. Until that time however the blood pressure had reached its maximum fall due to peripheral vasodilatation and this correlated well with the level of cutaneous anesthesia to and above the first thoracic segment. That the head was already down when the respiratory difficulties began gives further evidence that the latter were not due to anoxemia of the medulla resulting from fall in blood pressure. It is interesting to note that although there

was some fixation of novocain early, this was only partial and the effect continued to spread upward for 20 to 25 minutes after injection. It has been our observation that in older patients with sclerotic vessels and high blood pressure, the fall in pressure is apt to be sharper and more intense than in younger patients with elastic vessels and lower blood pressure. This does not contra indicate the use of spinal anaesthesia in older patients but necessitates the use of greater caution and the restriction of the anaesthesia to lower levels. The recovery of this patient must be ascribed to the artificial respiration instituted, since the essential cause of the reaction was respiratory failure and restoration of breathing was all important for recovery. However, the use of stimulants may have had some additional favorable effect adrenaline particularly stimulating the waning circulation.

EFFECT UPON INTESTINAL MOVEMENTS AND TONE

It has long been observed that spinal anaesthesia gives the greatest amount of relaxation in abdominal operations. This is no doubt due in part to the great muscular relaxation of the abdominal wall and to the absence of violent respiratory movements, but the condition of the intestine itself is of very great importance. It has been noted that the intestine is usually collapsed and free of distention a condition which has been of the greatest advantage in difficult surgical procedures. The basis for this condition has not been so clear though generally regarded as due to paralysis of the preganglionic sympathetic fibers in the roots of the fifth to the twelfth thoracic spinal nerves (splanchnics). Ochsner and Gage (1930) have shown a temporary cessation which is followed by hyperactive movements and increased tone after cutting the splanchnics. They have also found a similar effect from spinal anaesthesia reaching about the origin of the splanchnics.

Putting the cord in our experimental rats was followed by a marked increase in the rate and amplitude of intestinal movements as well as a general increase in tone. The following are protocols of typical rabbit experiments illustrating these points.

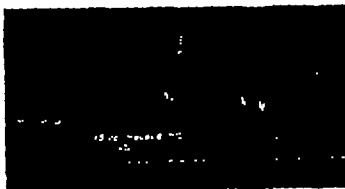


Fig. 9. The effect upon intestinal movements and tone of a lumbar subarachnoid injection of 0.15 cubic centimeter of 2 per cent novocain methylene blue solution. Dye reached to fourth thoracic segment. Rabbit.

Rabbit 17 Weight 2 kilograms. Anaesthesia, 2 grams urethane. A soft rubber catheter was inserted into the rectum for a distance of about 6 inches fixed with a purse string suture and sealed with collodion. The free end was connected with an air tambour the lever arm of which was made to write upon a kymograph. After a record of the normal intestinal movements and tone was obtained, 0.15 cubic centimeter of 2 per cent novocain colored with methylene blue was injected into the subarachnoid space through an upper lumbar laminectomy wound. After a very short latent period, there was a marked increase in the frequency and intensity of the intestinal movements with a general increase in tone (Fig. 9). At postmortem the anaesthetic solution was found to have reached to the fourth thoracic segment.

Rabbit 19 Weight to 2.8 kilograms. Anaesthesia, 2.8 grams urethane. Artificial respiration. Tambour was arranged as in preceding experiment. Both splanchnics were isolated just below the diaphragm. After a record of normal intestinal movements and tone was obtained, the left splanchnic was cut. This was followed by very little change in the record but, when the right splanchnic was severed there was an almost immediate increase in frequency and intensity of movements as well as tone. Injection of 0.2 cubic centimeter of 2 per cent novocain colored with methylene blue into the subarachnoid space was followed by a still greater increase especially in intensity of contractions (Fig. 10). Postmortem examination showed that the novocain solution had reached to the sixth thoracic segment.

These experiments show that spinal anaesthesia affects intestinal movements in the same way as cutting the splanchnics and that the effects must be due to paralysis of the preganglionic fibers in the nerve roots of the fifth to twelfth thoracic segments from which the splanchnics take origin. The additional effect produced by spinal anaesthesia after the splanchnics are sectioned is due to the fact that the section of the latter is of necessity

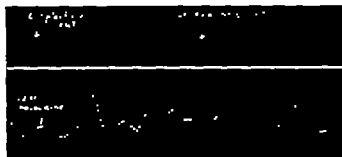


Fig. 10. Tracing showing the effect upon intestinal movements and tone of cutting the left and right splanchnics, respectively followed by a lumbar subarachnoid injection of 0.5 cubic centimeter of a per cent novocain methylene blue solution. Dye reached to sixth thoracic segment. Rabbit.

incomplete whereas spinal anesthesia catches all the fibers below its upper level. Because of this action on the intestinal tract, spinal anesthesia is not only advantageous for abdominal operations but may be used in the treatment of paralytic ileus. This method has often been successful after other measures have failed to control abdominal distention—especially postoperative distention.

SUMMARY AND CONCLUSIONS

1. Subarachnoid injection of novocain dissolved in spinal fluid produces a convenient and satisfactory anesthesia for operations of the abdomen, perineum, and lower extremities.

2. The height of anesthesia is dependent upon the volume and concentration of the solution, the rate of injection, the position of the patient and, to a lesser degree, the site of injection.

3. No definite levels for specific volumes and concentrations will hold for all patients but, by varying these two factors, the tendencies of spread can be anticipated.

4. In general, the use of 150 milligrams of novocain dissolved in 1 cubic centimeter of spinal fluid for work in the lower abdomen, perineum, and lower extremities and 200 milligrams in 1 to 2 cubic centimeters for work in the upper abdomen are most satisfactory. The duration of anesthesia is directly proportional to the concentration and inversely proportional to the spread.

5. The fall in blood pressure is dependent upon paralysis of the vasoconstrictor nerves or

center and not upon respiratory depression—at least not until the latter has ceased entirely. Adrenaline and ephedrine, acting upon sympathetic myoneural functions, are effective means of preventing and combating this fall in pressure. Keeping the head lowered during anesthesia is important in maintaining the blood supply to the medulla when the pressure is low but is only of secondary importance as far as changes in respiration are concerned.

6. The cause of death following spinal anesthesia is primarily respiratory due to action upon the peripheral respiratory nerves or upon the medullary center. The most effective treatment for respiratory failure is artificial respiration, although drug stimulants may be of some value.

7. Spinal anesthesia is a safe anesthesia when kept below the level of the mid dorsal region.

8. Spinal anesthesia causes an increase in intestinal movements and tone due to paralysis of the preganglionic sympathetic fibers (splanchnics) which carry the majority of inhibitory impulses to the intestine. This fact may be used clinically in the treatment of paralytic ileus.

We wish to take this opportunity of expressing our appreciation to Mr. Ivan D. Farnsworth and Mr. Howard Black, College of Medicine, University of Nebraska, for their valuable technical assistance in this work.

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FACTORS WHICH DECREASE RISK IN OPERATIONS ON COLON AND RECTUM

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IN the treatment of carcinoma of the colon and rectum, one inevitably finds that the condition unfortunately is not selective only among persons best able to undergo a major surgical procedure but that the selection is indiscriminate. Suffice to say that at least one factor in a low mortality rate is directly dependent, not on a well defined standardized technique for operating on growths in certain situations, but on the ability and judgment of the surgeon to determine the patient's condition and be guided by it to select the type of procedure best suited for the particular case.

In recent years operations on the colon and rectum although still fraught with many undesirable features have been accomplished with a degree of proficiency which materially enhances the prognosis in such cases. The operative mortality as well as the morbidity has been reduced materially. However the very nature of the pathological changes, usually malignant encountered in these cases and the site of the lesion in a heavily contaminated and infected bowel precludes the possibility of obtaining results comparable with those obtained in the upper part of the gastro-intestinal tract where the bacterial content is less profuse and many of the lesions are benign. Many years ago Cushing demonstrated that the bacterial content became greater in the more distal portion of the intestinal tract, and reached its maximum in the terminal portion of the ileum. If one considers only malignant conditions of the upper and lower parts of the alimentary tract, the percentage of operability and end results of carcinoma of the colon and rectum do not suffer by comparison with neoplasms of the stomach and small intestine, although this may not be equally true of immediate operative mortality.

Many individual factors have contributed to the increased safety of present day treat-

ment of colonic and rectal lesions. A few of the more important factors may be divided into three groups: pre-operative, operative, and postoperative.

PRE-OPERATIVE FACTORS

In cases in which the symptoms point to a possible lesion in the colon or rectum, it should be remembered that the administration of barium by mouth makes a serious condition more serious. Lesions of the large intestine and rectum rarely cause complete obstruction particularly those of a malignant nature. However partial obstruction is almost invariably present in fact it is usually because of this mechanical interference with the motor mechanism that symptoms develop. If barium is administered orally in such cases, as is often done complete obstruction may be produced the very thing one strives to overcome. Figure 1 is illustrative of such a case. The lesion was in the descending colon. Barium was given by mouth and complete obstruction occurred soon afterward. Enterostomy was necessary to save the patient's life.

An aerogram affords superior visualization of the colon, and if a lesion is found to be present obstruction may be obviated. In making the aerogram an enema of thin barium is given and the patient is allowed to expel it immediately as thoroughly as possible. Then by means of a small bulb syringe air is introduced into the rectum until the colon is slightly distended. The procedure is carried out under direct fluoroscopic visualization. It will be found that sufficient barium will adhere to the mucosa of the colon so that a lesion, if present, is easily discernible.

If a lesion of the colon or rectum is suspected a careful digital examination should always be made. All lesions of the rectum and many of the lower part of the sigmoid can be felt. Occasionally a lesion of the middle of the sigmoid becomes intussuscepted and can

be felt by the examining finger. Proctoscopic examination serves to identify lesions of the lower part of the bowel within 24 to 28 centimeters from the anal margin, and their gross appearance in most instances makes it possible, as a rule, to determine their nature and extent. A specimen should be removed on proctoscopic examination for microscopic study, because in many instances the grade of malignancy with other factors may be of value in determining the type of surgical procedure to be carried out. The roentgenogram furnishes tangible information concerning the situation and nature of lesions higher in the rectum.

To facilitate transfusion should it be necessary, typing of blood should be done in all cases in which surgical lesions of the bowel are present.

After the diagnosis is established, 3 to 5 days' hospitalization prior to operation is extremely desirable. During this time particular attention is given to the general condition of the patient and to the proper preparation of the abdomen and colon. A diet high in carbohydrates and low in residue is recommended. An effort is made to establish a reserve of carbohydrate energy which will be readily available for the first few days following operation. A generous supply of fluids is likewise advisable. Frequently, if pronounced anemia exists, especially in the presence of a growth in the right half of the colon, one or more transfusions greatly increase the general forces of resistance.

Vaccine (streptococci and colon bacilli) is administered 3 days before operation as a routine thus permitting the proper interval for the optimal extent of mobilization of the peritoneal defensive forces prior to operation. In preparing the bowel itself an initial mild cathartic, that is, citrate of magnesium may be advisable in some cases. During the 48 hours prior to operation, a low residue diet, and warm enemas, twice daily, of physiologic saline solution aid in emptying and cleansing the bowel on the morning of the operation. Generous doses of paregoric may be given during the first 12 of the last 24 hours before operation. In event the saline enemas are inadequately expelled the colon is aspirated

in the morning before operation. Care should be taken to have patients void immediately before operation. A filled urinary bladder does not increase the visibility in operating in the pelvis.

OPERATIVE FACTORS

There are numerous and diverse factors, from an operative viewpoint which may contribute to the safety of the patient suffering from a growth in the colon. These factors may be divided into two main groups: those involving surgical judgment, and those concerned primarily with surgical technique.

In the first group, the most important factor is the choice of operation, this is of particular significance in cases of lesions in the left side of the colon and in the rectum. What might be the ideal operation for a robust patient of middle age would likely prove too strenuous for one less sturdy and of more advanced years. As a rule, a fine balance must be drawn between the desire to perform a radical operation which offers the best ultimate prognosis, and a less extensive operation with a lower initial mortality and less chance for cure. The experience and ability of the surgeon and his familiarity with this field should influence the decision.

In dealing with lesions of the rectum and rectosigmoid, the choice of operation ordinarily lies between five different procedures: local excision, posterior resection with a sacral anus, colostomy and posterior resection (one or two stages), combined abdominoperineal resection in two stages, or combined abdominoperineal resection in one stage, as advocated by Miles. The main points to be considered in selecting the proper operation for the individual patient are age, general condition, grade of malignancy, local extent of the growth, and the experience and ability of the surgeon. In cases in which patients are particularly debilitated and of advanced years, and the grade of malignancy is comparatively low (1 or 2) treatment by radium and roentgen rays may be carried out. If after 6 or 8 months examination reveals a marked decrease in the size of the lesion, a surgical procedure which enables the continuity of the bowel to be re-established may be attempted.

The more radical procedures which favor cure may be employed as a routine in a given case unless contra-indicated. Malignant lesions graded 4, fortunately uncommon in this situation, are not suitable for operation; however the surgeon is loath not to attempt radical removal because occasionally such removal may afford the patient many additional years of comfort.

In cases of growths of the descending colon and sigmoid, the choice of operation is usually between obstructive resection, a Mikulicz operation or some type of modified anterior resection. Primary resection with end-to-end anastomosis is prohibited by a high operative mortality. The Mikulicz operation although perhaps the safest procedure from the point of view of immediate recovery may not entail widespread removal of the node bearing area, and may be followed by local recurrence. However many patients are alive 10 years or more following resection by this method. Resection also affords by far the most desirable palliative procedure if it is performed in the face of extension beyond the site of operation. For lesions of the transverse and descending colon obstructive resection, as described by Rankin, is deserving of consideration. An accompanying colostomy is often of value. Carcinoma of the cecum or ascending colon is best removed by ileocolostomy either as a preliminary procedure to or associated with resection of the right half of the colon. The two stage procedure in most cases is probably the wiser. If death occurs following a one stage resection one can all ways realize in retrospect, that a procedure of less magnitude could have been adopted.

The selection of an anesthetic agent is ever a moot question and to some extent is dependent on the facilities immediately available. For perineal work, a sacral block is practically ideal. If the peritoneum is opened the patient will experience some discomfort for which a small amount of gas may be administered. Spinal anesthesia has the advantage of affording complete relaxation and ablation of peristalsis for several hours subsequent to operation. If there is too much traction on the mesentery nausea or straining will occur which to some extent overcomes

these advantages. Thus anesthesia is considered advisable in the presence of pulmonary complication or when operating on excessively obese patients. It is less suited to patients with marked hypertension, arteriosclerosis, extreme nervous instability or to those of advanced years. If spinal analgesia is contemplated proper preliminary medication by mouth is particularly advantageous. We use pentobarbital sodium, grains $1\frac{1}{2}$ (0.1 gram) the night preceding operation and a similar amount one hour before operation supplemented by morphine grain $\frac{1}{4}$ (0.01 gram) with atropine sulphate grain $1/150$ (0.0004 gram). A properly administered inhalation anesthesia with induction of nitrous oxide or ethylene and ether for maintenance still remains difficult to excel in many cases. As with most variables in surgery it is unwise to permit the use of a given anesthetic as a routine for a certain operation, and thereby individualize a technical procedure in preference to individualizing the patient.

The general plan of resecting the colon and rectum in two and occasionally in more stages, in contrast with primary resection, has received and has merited considerable attention. The advantages of this plan especially if operation is performed on a debilitated patient, are numerous. The shock and severity of the initial operation are greatly reduced. At the time of the second operation the patient has, to some extent, vaccinated himself against subsequent insults of peritoneal contamination. Many times, a growth densely adherent and fixed when first encountered will become sufficiently mobile during the ensuing few weeks, because of recession of surrounding inflammatory processes, to permit resection without widespread dissection and trauma. The patient is not suffering from the effects of a long standing partially obstructing lesion and is therefore in the best possible condition at the time resection is performed. The time between the stages of operation may be varied according to the general condition and age of the patient and also the smoothness of convalescence following the initial operation. A patient whose general health is good and who recovers rapidly following the primary surgical procedure, which is usu-

ally decompression in one form or another, may well be kept in the hospital for 3 to 4 weeks, when the second stage may be performed safely. If patients are of advanced age perhaps with complications during convalescence from the first stage such as a pulmonary infarct, phlebitis, or parotitis, they should be allowed a more prolonged (4 to 6 weeks) period of rest before resection is undertaken. On the other hand, in our enthusiasm for operations in stages, a number of comparatively young and sturdy patients are probably denied the privilege of primary resection, with the resultant advantages of immediate removal of a malignant growth and shortened stay in hospital. Here again, surgical judgment and consideration of patients individually should be paramount. Occasionally we find unexpected extension of a malignant growth at the second operation, even if only a few weeks have elapsed. This is unusual, and is most prone to happen among young persons or those who harbor a highly malignant neoplasm. Initial extirpation in such cases is most desirable and usually feasible. If, for any reason, the growth is not primarily removed its ablation should be postponed no longer than is absolutely necessary.

Various problems arise at the time of operation which demand careful consideration and judgment on the part of the surgeon if the patient is to have the benefit of all possible factors of safety. Prominently, in this regard, arises the desire to perform some type of obstructive operation for lesions of the distal half of the colon in the presence of distinct evidence of chronic or even subacute obstruction. When acute obstruction exists there is no question but that immediate and simple decompression should be the procedure of choice. Even when the obstruction is chronic primary resection, although it may appear desirable, should not be performed. In the presence of a thick walled and somewhat dilated colon thought should be given to drainage and physiologic rest for the involved segment, with all thought of resection postponed to a subsequent date. It is often a great temptation to overlook this consideration when one encounters a small, encircling, freely movable growth, but strict adherence

to this plan will usually afford far superior results. A Mikulicz operation can often be carried out safely under such conditions, however, the indications for this operation are limited.

Cæcostomy is often a life-saving procedure. "Blind cæcostomy" finds its greatest field of usefulness in the relief of acute obstruction of the large bowel, of unknown site and etiology. If the portion of the cæcum brought out of the abdomen is walled off from the abdominal incision by means of vaseline gauze it may be punctured in 6 or 8 hours with safety and the critically ill patient can be restored to comparative health preparatory to adequate observation, and subsequent surgical procedures can be directed toward cure. Acute obstruction, if the patient is of advanced years, developing suddenly, is usually caused by a carcinoma of the colon distal to the hepatic flexure. The obstruction may not be complete and may be partially alleviated by gentle irrigations. In certain other cases, usually in association with more or less extensive surgical procedures on the distal half of the colon, the establishment of a safety valve, in the form of cæcostomy, materially reduces the risk of operation. If there is no such opening in the cæcum, occasionally postoperative ileus or temporary obstruction will develop and, if it is not relieved, will result in such marked dilatation of the bowel that the intestinal musculature apparently becomes paralyzed and unable to restore the bowel to normal, although the original etiological factor for the dilatation is removed later. Likewise when the right half of the colon is resected in a one stage operation and ileocolostomy is performed, it is wise to establish temporary ileostomy at the same time, otherwise it may become necessary as an emergency procedure under less desirable conditions.

The advisability of draining the operative site following various surgical procedures on the colon may usually be decided without difficulty, according to certain general surgical procedures. When large pockets are left behind, even after complete peritonization, as in resection of the right side of the colon, it is wise to insert a small soft rubber tube to permit subsequent discharge of collections of

serous material. Likewise, if there has been gross contamination, drainage of the involved area is most desirable. Vaginal drainage may sometimes be carried out to advantage for example in cases of total colectomy. The drainage of posterior wounds following excision of the rectum can well be reduced to a minimum as large packs of gauze left in place for several days merely prevent adequate drainage and promote local absorption of toxic material. If these wounds are properly cared for after operation, we need not fear collections of toxic material in pockets which are so frequently caused by local areas of rapid healing.

In the second group are numerous factors pertaining to actual operative technique which tend materially to reduce the hazard of surgery. Although technical maneuvers vary in details with each individual operator, certain general principles are equally applicable in every surgical attack on the large bowel. Prominent among these principles is the policy of reducing to a minimum the handling of any growths of the colon. All tumors of the colon are heavily infected, and the organisms and products of inflammation are not limited in their extent to the mucosa, but tend to invade the wall of the bowel and adjacent lymph channels. Handling or trauma of any description promotes direct contamination of the serosa and surrounding peritoneum, even though the bowel is not actually torn. It is partially for this reason that in performing combined abdominoperineal resection for carcinoma of the rectum or rectosigmoid, many surgeons consider it advisable first to mobilize the rectum posteriorly, encase it in a sterile rubber glove and then open the abdomen to complete the operation. By performing resection in this sequence, mobilization of the highly infected portion of the bowel in which the growth is situated is all done extraperitoneally. If the growth is intra-abdominal, all exploration should be done first, and then the operative site should be packed off from the remainder of the abdomen. Last of all attention should be directed to the growth itself.

Before mobilization of any lesion of the rectosigmoid or sigmoid, the left ureter should be identified. Although frequently this may

seem superfluous, nevertheless as the dissection is continued, even the most experienced surgeon may hesitate just in time or a little too late to avoid this structure. Only rarely does the right ureter become involved in the region of growths in the colon, however, when the pelvis is filled with a densely adherent mass, accurate localization of the right ureter is not a wasted gesture.

Great emphasis has always been placed on the paucity of the blood supply to the colon. The importance of maintaining adequate circulation in any surgical procedure on the large bowel has been stressed frequently and many calamities have been credited to failure to observe this point. The recent excellent work of Steward has shown that the arteries to the colon are far more constant than was previously supposed, although there may be some variation in the course of the branches. One simple rule suffices to obviate most difficulty in this regard. After the observance of ordinary anatomical facts, one need merely determine, by close observation, the presence or absence of pulsations in the vessels supplying the segment of bowel in question. There pulsations are readily seen, if they are present and afford positive proof of arterial circulation in the region where they are visualized. If they cannot be found, further resection is generally indicated.

Accurate peritonization of all raw surfaces is important; it is, of course, a cardinal surgical principle regardless of the intra-abdominal viscus to be attacked. It is of particular importance in the formation of a new peritoneum of the floor of the pelvis after the completion of a combined abdominoperineal resection, as weakness in this diaphragm may be most disastrous. Accurate peritonization is also essential following resection of a lesion in the right side of the colon or in the sigmoid.

POSTOPERATIVE FACTORS

Patients subjected to surgical procedures on the colon are prone to have as a group a more disturbed postoperative course than those on whom the average laparotomy is performed and for this reason they require more careful postoperative supervision. Here again, adherence to certain general principles



Fig. 1 Obstruction caused by the administration of barium orally

affords the greatest number of satisfactory results.

During the first few days the abdomen must be kept quiet. To accomplish this, as well as to relieve pain, morphine may be used liberally for the first 48 hours. It is usually safer not to give fluids by mouth until gas is expelled from the bowel. The administration of small quantities of water by mouth is begun usually 48 to 60 hours after operation. When the patient is taking nothing by mouth, and even after fluids have been started cautiously, the mouth should be kept moist and clean as an aid in the prevention of parotitis, which seems especially prone to affect patients subjected to operations on the colon. During this interim the fluid balance is maintained by means of hypodermoclysis of physiologic sodium chloride solution and occasionally with intravenous injections of a 5 or 10 per cent solution of glucose. The fluid should be administered intravenously cautiously and slowly, one liter of saline solution should require 1 hour, saline and glucose solution 2 hours and given under the direct supervision of a physician. In recent years the popularity of intravenous injections has increased tremendously but not without dire as well as beneficial results. The use of intravenous solutions

as a routine method of supplying an adequate intake of fluids seems inadvisable. The ease with which these solutions are prepared and administered has augmented their popularity, and although they are a great boon in many cases, their promiscuous use may cause undesirable effects. They are more likely to provoke unfavorable reactions if patients are obese, have short necks, hypertension and arteriosclerosis, weakened myocardium, or in the presence of considerable infection. If there has been evidence of phlebitis, thrombosis, or pulmonary infarcts, solutions should not be given intravenously. The ideal solutions have been found to be physiologic saline, 5 or 10 per cent glucose, and 5 per cent glucose in physiologic saline.

Occasionally, when the patient's resistance has been lowered by a few difficult postoperative days, transfusion of blood will often effect a surprising turn for the better. This may be repeated as indicated.

In the treatment of ileus, hot stupes, pituitary extract or physostigmine or at times, acetylcholine have proved of some benefit. Most patients respond to this treatment, although sometimes enterostomy, even in the absence of actual mechanical obstruction, is indicated and affords satisfactory results. The intraspinal injection of procaine has in many instances been dramatic in its relief of ileus. It should be administered, however, before process has reached stage producing shock.

The etiological factor of parotitis which so frequently develops following operations on the colon remains undetermined although the treatment of the condition by the early application of radium is most satisfactory. Occasional repeated applications are necessary but after the proper amount has been administered the swelling disappears and suppuration does not occur. Rarely the same type of inflammatory process is seen in the submaxillary gland. Pulmonary, cardiac, urinary and other complications when they occur, are treated much the same as they are following any type of surgical procedure.

SUMMARY

Careful pre-operative study and adequate preliminary preparation of the colon, abdomen, and general metabolic reserves en-

hance the surgical prognosis in cases of malignant lesion of the large bowel. The consideration of patients individually which entails the judicious selection of operative procedure and the proper technique for its consumma-

tion is an essential prerequisite for satisfactory results. Intelligent postoperative care, based on an accurate appreciation of the altered pathological physiology adds further to the patient's safety

STUDIES ON THE IMMOBILIZATION OF THE NORMAL JOINTS¹

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WITH the advent of the modern treatment of fractures, much has been written concerning the prompt restoration of motion and ensuing lack of joint limitation resulting from the early mobilization of joints. This has been contrasted with stiffness and loss of motion frequently found in those limbs which have been fixed for a long period in a rigid dressing such as plaster of Paris and the advocates of early joint motion have declared that disability periods can be shortened and function can be more quickly restored and permanent disability can be lessened if their recommendations are followed. Clay Ray Murray of New York, has written extensively on this subject and states that in his cases treated with early motion the period of disability was materially shortened.

Although a great deal of opinion has been voiced as a result of clinical observation, very little experimental work has been done of recent years to verify or disprove these observations. On the other hand, there are still quite a few men of prominence who believe that immobilization of a normal joint has little effect upon its structure and that the above mentioned procedures frequently do a great deal of harm and very little good. They further claim that when stiffness of joints does result it is because the joints that are immobilized are not normal in character but are suffering from some pathological condition. It is asserted by many that prolonged immobilization of joints, already the seat of inflammation, will tend to cause changes that are difficult subsequently to eradicate. This assertion seems to be based solely on clinical

observation. It is the only hope of function in some cases. In favor of the lack of damage by immobilization its advocate brings forth the fact that the joints of children can be immobilized for weeks or months and when released from apparatus rapidly return to normal function without disability.

Because of this confusion and of paucity of actual experimental work done upon this subject we have made an effort to review and check the work that has been done and to determine if possible, just what pathological changes may occur in the experimental animal following immobilization.

Carl Reuber in 1874 showed in experimental animals that certain definite changes occurred from prolonged inactivity. He noted that in the cartilage beyond the surfaces that are habitually in contact large round cartilage cells passed by gradual acquisition of cell processes into spindle shaped or stellate connective tissue corpuscles of the synovial membrane. In 1909, P. W. Nathan speaking of joint cartilage stated that it is a resistant inert substance which stands a marked amount of irritation without noticeable change in structure. When destroyed it does not regenerate. It does not exhibit inflammatory changes. Proliferation is only in response to function. In 1916 Ely and Cowan in experimental work on animals, reported similar findings. Nathan further notes that the normal layer of vascular connective tissue at the periphery of the joint where surfaces are not in contact increases when there is loss of function and decreases when there is an increase in function.



Fig. 1. left. Periphery of joint showing normal proliferation of the areolar tissue. Note the relative width of the joint space and the smooth outline of the articular cartilage.

Fig. 2. Dog 3. The encroachment between the articular surfaces. Note the roughening and changes in the hyaline cartilage of the opposing joint surfaces.

The last authentic work to be done on this subject is that by Walther Muller in 1923 who made the following observations. Only extreme grades of fixation give apparent discernible changes and then only after a long period of immobilization. The limitation of joint motion is first caused by shrinkage of the adjacent muscles and the capsular structures. In extreme grades of immobilization by means of skeletal traction and fixation of plaster of paris we find an apparent ingrowth of the connective tissues from the periphery of the joint, growing to the point where the articular surfaces are in apposition. This is similar to a condition which takes place in joints where an old dislocation has been unreduced. He also noted some thinning of the joint cartilage with a tendency toward necrosis and fibrous degeneration.

OUTLINE OF EXPERIMENTS

For our purpose four adult dogs were selected and under anesthesia their right hind legs were immobilized in plaster of paris, from the toes to above the knee joint. These plaster dressings were retained for a period of 1 to 3 months. The animals were then sacrificed

and their ankle joints examined both microscopically and macroscopically. In order further to control the situation and give us a basis of comparison, a normal joint was taken from a dog which was of similar age, healthy, had not been subjugated to this enforced inactivity.

In one or two cases the plaster was either lost or destroyed by the animal on several occasions, but promptly reapplied before any effort had been made to utilize the joint under observation. We do not believe that these complications had much effect upon the ultimate findings, as under the microscope all specimens showed certain definite variations from normal.

Observation on removal of the plaster in some cases showed some apparent soft tissue swelling about the joint, but no attempt at eliciting the range of motion was made in order not to disturb any changes that might have occurred which could be subsequently identified under the microscope.

Dog 1. February 24, 1930. A large brindle colored male half wolf and half police dog was given morphine sulphate and anesthetized with ether and the right hind leg from foot to knee was put up in



Fig. 3



Fig. 4



Fig. 5

Fig. 3 High power photomicrograph showing the thinning, irregularity and fibrillation of the joint surfaces following immobilization.

Fig. 4 Dog. Elimination of the joint space with substitution of fibrous tissue and fibrous cartilage for hyaline cells.

Fig. 5 High power photomicrograph showing close approximation of the surfaces of the joint with destruction of the cartilage and replacement of the fibrous tissue.

plaster of paris. Anesthesia was given merely for the purpose of having the dog quiet until the cast had been set. March 8, 1930, lost plaster dressing. In afternoon March 13, 1930 plaster was renewed. March 31, 1930, plaster came off. April 1, 1930 plaster was renewed. The knee was freely movable. April 18, 1930, the plaster was renewed. The old one was partly chewed off and there was some swelling just above the ends of the casts. April 22, 1930 dog lost the plaster. It was renewed after 4 hours, and reinforced with tin lining. There was some rawness on leg underneath cast. Aristol powder was applied. May 10, 1930 dog lost plaster again. It was renewed early in the morning and he chewed it off again next day. May 12, 1930 dog was killed with gas. No swelling was noticed.

Dog 2. March 3, 1930, a white adult male dog, terrier type, was anesthetized with ether and a plaster-of-paris cast was applied to the right ankle. May 20, 1930 the dog was killed with chloroform. No swelling was present in the right leg but the left leg showed considerable edema from the knee down. The swelling was due to bite in groin by other dogs with resultant interference with the blood supply. The leg showed great extravasation of blood.

Dog 3. March 3, 1930. A tan brown female, still young, had a plaster-of-paris cast applied to right ankle, under ether anesthesia. April 14, 1930, the dog lost cast, which was renewed at 1 p.m. There was some swelling around the ankle and up to 3 inches below the knee. The cast was lost again the

same evening. April 15, 1930 cast was renewed at 8:30 a.m. April 24, 1930, dog lost cast at noon. There was some swelling around the joint. New cast was applied at 5 p.m. April 29, 1930 dog lost cast and was killed with chloroform. The knee was slightly swollen.

Dog 4. March 13, 1930. A large long haired, black and white male dog had a cast applied to the right hind leg at the ankle, just as in previous animals. April 14, 1930, dog died. This cast was still intact. At postmortem examination no gross changes were noted on inspection.

After fixation and decalcification sections were made of the entire ankle joint, showing both the talocrural and the talocalcaneal articulations stained with hematoxylin and eosin. Study of these in all the animals disclosed the following findings. The articular cartilages seem to be closer approximated the surface layer of the cartilage was definitely roughened and shaggy. The thickness of the cartilage was decreased at the point where the greatest pressure of the apposing articular surfaces occurred. In places between the articular surfaces were found isolated irregular bands of fibrous tissue containing only a few cells, and in places were masses of homogenous staining

material with the characteristics of fibrin. This was more marked in the case of Dog 1. These were apparently tags of synovial membrane with fibrin formation, for further section showed an apparent continuity of this tissue with some of the articular cartilaginous surfaces, the edges of which had become irregular. The cartilage matrix was degenerated, with a definite decrease in the number of hyaline cartilage cells present. Here there was a substitution of a stellate type of cell resembling the connective tissue variety. Adjacent to these areas were definite points of vacuolization usually close to the peripheral margin. The remaining cartilage while of apparently normal cell content stained noticeably deeper, as though increased calcification was present. This was not primarily a decrease in calcification in the degenerated areas, as the normal tissue which was put through the same staining process was noticeably lighter in contrast. At the periphery of the joint a marked change was apparent, with an increase in the amount and density of the fibrous tissue. This had definitely invaded the cartilaginous surface with a condensation of the hyaline matrix and a loss of the hyaline type of cell. A structure resembling fibrous tissue was found to replace the normal cartilage, forming a cell of the stellate variety, in some places invading the cartilage to a depth of 25 per cent of its thickness. Occasionally this tissue had penetrated the cartilage and could be seen invading the subcartilaginous zone. The replacement cells were of a closely woven stellate type in parallel bands, blending with the tissue normally found on the periphery which is of the loose areolar type. In some sections this infiltration of fibrous tissue extended for a distance of $\frac{1}{4}$ of the low power field into the joint itself from the periphery.

In the subchondral zone the bone trabeculae were not sharply defined and in places the marrow spaces were filled with large numbers of red blood cells. In one case, however in which the dog was considerably younger than the others, there was distinct evidence of lymphoid infiltration. This fact brings up the question as to whether the change in the joint

caused by immobilization differs in young and older animals. We hope to investigate this matter later.

CONCLUSIONS

Definite microscopic anatomical changes were noted as follows:

- 1 The cartilage shows a closer approximation of articular surfaces.

- 2 There is thinning, irregularity, fibrillation and in places vacuolization of the cartilage.

- 3 Fibrin plaques are evident between the joint surfaces apparently related to the synovial membrane.

- 4 The areolar tissue about the periphery of the joint becomes of a denser consistency and encroaches between the articular surfaces in places causing a substitution of the cartilage with connective tissue type of cell.

- 5 No definite fibrous adhesions are demonstrable between the joint surfaces.

The results of this work have confirmed in our opinion, that the conclusions of previous investigators who have found definite anatomical changes in joints as the result of immobilization, are correct. The findings of both Reuber and Nathan were present with striking regularity in all sections.

We cannot entirely agree with Muller who while confirming the anatomical observations of earlier investigators, stated that only extreme grades of immobilization give discernible changes. In our series the immobilization was not complete as if the bone had been in plaster of paris with skeletal traction nor was the immobilization constant during the entire period. However, in spite of the absence of these factors the fixation was complete enough to give the microscopic picture above described.

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THE EFFECT OF ANTERIOR HYPOPHYSIS ON CONCEPTION AND PREGNANCY IN THE GUINEA PIG¹

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THIS investigation was undertaken somewhat as a corollary to one previously reported concerning the effect of injections of estrin on conception and pregnancy in the guinea pig (6). Since it had been found that estrin in small doses prevented conception and in considerably larger doses terminated pregnancy it was considered possible that stimulation of the follicular apparatus of the ovary might result in the production of sufficient estrin to bring about the same results.

The possibility was suggested by the well known work of Smith and Engle and of Zondek and Aschheim on the relation of the anterior hypophysis to the gonads. After this work was undertaken a report by Evans and Simpson was seen which stated that occasionally premature birth resulted from the stimulated production of folliculin. Engle and Mermod reported that transplants of anterior hypophysis in rats and mice terminated pregnancy uniformly in the first two-thirds and often in the last third. They thought sufficient dosage would do so in this stage also.

Subsequently followed efforts to differentiate the hypophyseal hormones, and the opinion became general that there are two such principal hormones affecting the ovary, one a follicle stimulating and the other a luteinizing hormone. These separated hormones were not

available for this investigation though an extract from the urine of pregnant women was supplied by a manufacturer.² There is no doubt that both hormones were present in this extract though the luteinizing element attracted more attention due to its terminal effect on the ovaries of the test animals.

In this connection it is interesting to note that Lepine determined the co-existence of both antagonistic hormones and found that one brought about follicular maturation of the adolescent female and abortion of the pregnant female while the other caused the formation of hemorrhagic follicles and the yellow bodies. Werchatsky reported that injections of a hormone extract from the urine of women in the second period of pregnancy into pregnant animals resulted in abortion. Gastfirovic reports ovulation produced by the luteinizing hormone (Prolan B).

In addition to the urine extract, freshly expressed juice of anterior lobes of bovine hypophyses was used. The glands were obtained from the slaughterhouse and the injections made within less than 2 hours after the animals were killed. The capsules of the glands were stripped off and the organs laid in half in the mid sagittal line. The anterior lobe was separated from the remainder of the gland and then finely minced. The mass of minced tissue was next placed within a special press of very powerful design³ and the juice squeezed from it. The juice was then strained and injected subcutaneously.

Injections were usually made daily for several days. One per cent peptone solution was injected into the control animals.

Fully matured guinea pigs well housed and nourished were used as test animals and controls. Copulation was checked by the presence of fresh sperm in the vagina. If mated without the finding of sperm the females were isolated from the males. Sperm are quickly



Fig. 1 Internal genital organs of immature albino rat, used as control

¹Kindly furnished by Parke, Davis & Company
²Manufactured by A. Mearl & Co. Chicago

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destroyed in the vaginal canal and some of the animals became pregnant though sperm were not seen. These were later used for the abortion test. (Unless examination is made fairly soon after copulation sperm may not be demonstrable.)

It was found that the injection of the peptone solution did not effectively prevent conception, as two of three animals conceived after having received it (see Table I). Neither did the solution produce abortion (see Table II).

Four series of test animals were used. Two series received the fresh juice of the bovine hypophyses and two the urine extract. Animals that had just copulated and others of various stages of pregnancy were used.

One series of 11 animals injected after copulation to test prevention of conception received the juice of from three to ten hypophyses. Eight of these animals conceived and 3 died. Since conception was not prevented in any of the animals that survived, no interference with this function occurred. The cause of death in the 3 animals that died was presumably protein intoxication from the injected material (see Table III).

Another series consisting of 4 definitely pregnant animals received each the juice of from three to twelve glands. All of these animals died, probably from the same cause as those listed in Table III. All aborted within a day following the last injection and died within 2 days after that injection. The one hundred per cent mortality in this series contrasts with that of 27 per cent in the preceding series and was probably due to the fact that the animals were pregnant when injected (see Table IV).



Fig. 2. Genital organs of a mate of the control animal of Figure 1 after injection of 5 cubic centimeters of urine extract daily for 5 days (500 units). Hypertrophy marked.

TABLE I—CONTROL ANIMALS INJECTED WITH 1 PER CENT PEPTONE SOLUTION BEGINNING DAY OF COPULATION

| Animal No. | Copulation date | Peptone c.cm. | Injections | Total c.cm. | Result |
|------------|-----------------|---------------|------------|-------------|---------------|
| 140 | 6-5-30 | 5 | 6 | 3 | Conceived |
| 1175 | 6-5-30 | 0.5 | 6 | 3 | Conceived |
| 157 | 6-5-30 | 0.5 | 6 | 3 | Extra 6-23-30 |

TABLE II—PREGNANT CONTROL ANIMALS INJECTED WITH 1 PER CENT PEPTONE SOLUTION

| Animal No. | Copulation date | Pregnant days | Peptone c.cm. | Injections | Total c.cm. | Pregnancy |
|------------|-----------------|---------------|---------------|------------|-------------|------------|
| 52 | 2-22-30 | 3 | 1/4 | 9 | 2 1/4 | Unaffected |
| 1134 | 2-28-30 | 40 | 5 | 9 | 41 | Unaffected |
| 1040 | 3-21-30 | 42 | | 1 | | Unaffected |
| 17 | 3-28-30 | 35 | | | 1 | Unaffected |
| 30 | 4-3-30 | 28 | 1 | | | Unaffected |

A series of 8 females was injected just after copulation (that is beginning the same day) with the urine extract. Each animal received a total of from 5 to 10 cubic centimeters of the extract each cubic centimeter containing 50 rat units of hormone, or a total of from 250 to 500 units. Six of these animals conceived and 2 did not. It is interesting to note that there were no deaths in this series. Since all matings cannot result in conception it can be seen that with a 75 per cent conception rate



Fig. 3. Photomicrograph of ovary of immature guinea pig after 5 daily injections of 100 units each of urine extract, showing massive luteinization and included ova.

TABLE III.—TEST ANIMALS INJECTED WITH FRESHLY EXPRESSED JUICE OF ANTERIOR LOBE OF BOVINE HYPOPHYSIS JUST AFTER COPULATION

| Animal No. | Injections | Each (glands) | Total (glands) | Prevent conception | Died |
|------------|------------|---------------|----------------|--------------------|------|
| 10 | | 2 1/4 | 2 1/4 | No | No |
| 5 | | 2 | 2 | No | No |
| 20 | | 2 1/4 | 2 1/4 | No | No |
| | | 2 | 2 | No | No |
| 25 | | 2 1/2 | 2 | — | Yes |
| | | 2 | 2 | No | No |
| | | 2 1/2 | 6 | — | Yes |
| 30 | | 2 1/2 | 6 | No | No |
| | | 2 | 2 | No | No |
| 35 | | 4 | 4 | — | Yes |
| | | 4 | 6 | No | No |

TABLE IV.—PREGNANT TEST ANIMALS INJECTED WITH FRESHLY EXPRESSED JUICE OF ANTERIOR LOBE OF BOVINE HYPOPHYSIS

| Animal No. | Days pregnant | Injections | Each (glands) | Total (glands) | Aborted | Died |
|------------|---------------|------------|---------------|----------------|---------|--------|
| 6 | 27 | | 2 1/2 | | 2-2-20 | 2-2-20 |
| 3 1/2 | 5 | | | 2 | 2-3 | 4-11 |
| 3 | 4 | | | 2 | 4-3 | 1-2-21 |
| 2 | 4 | | 2 1/2 | 6 | 4-2 | — |

no particular interference with conception was to be observed here (see Table V)

In the last series 14 pregnant animals received each from 5 to 27 cubic centimeters of the extract. Eleven of these animals aborted 1 delivered at term and 2 died (see Table VI)

Throughout this work it was found that the urine extract was not stable and new material was frequently received for carrying on the investigation. The use of deteriorated extract no doubt explains the failure to produce abortion in animal No. 1530 in Table VI though material was injected that should have contained 1350 units, much more than was necessary in any other animal. Even up to the present the writer does not know of a thoroughly stable preparation of this kind.

To determine the potency of the two products used in making the injections some of each was injected into both immature guinea pigs and white rats. It was found that the urine extract had the more pronounced effect

TABLE V.—TEST ANIMALS INJECTED JUST AFTER COPULATION WITH EXTRACT OF URINE FROM PREGNANT WOMEN (50 RAT UNITS PER C.C.M.)

| Animal No. | Injections | Total units | Prevent conception | Died |
|------------|------------|-------------|--------------------|------|
| 201 | 2 | 200 | Yes | No |
| 212 | 2 | 200 | No | No |
| 224 | 2 | 250 | No | No |
| 236 | 2 | 200 | No | No |
| 247 | 2 | 200 | No | No |
| 250 | 2 | 200 | No | No |
| 264 | 2 | 200 | No | No |
| 273 | 1 | 450 | Yes | No |

TABLE VI.—PREGNANT TEST ANIMALS INJECTED WITH EXTRACT OF URINE FROM PREGNANT WOMEN (50 RAT UNITS PER C.C.M.)

| Animal No. | Days pregnant | Injections | Total units | Aborted | Died |
|------------|---------------|------------|-------------|---------|------|
| 201 | 44 | | 200 | Yes | No |
| 205 | 26 | 4 | 200 | Yes | No |
| 217 | 44 | 2 | 50 | No | Yes |
| 226 | 44 | 2 | 200 | Yes | No |
| 2 | 29 | 6 | 600 | Yes | No |
| 227 | 22 | 6 | 200 | Yes | No |
| 227 | 47 | 6 | 600 | Yes | Yes |
| 229 | 61 | | 80 | Yes | No |
| 230 | 4 | 9 | 130 | No | No |
| 226 | 43 | 6 | 600 | Yes | No |
| 24 | 43 | 7 | 850 | Yes | No |
| 230 | 22 | 6 | 600 | Yes | No |
| 226 | 2 | 6 | 600 | Yes | No |
| 227 | 2 | 6 | 600 | Yes | No |

*Used twice.

in producing hypertrophy of the internal genitalia but that the fresh juice of hypophysis was also active could be seen by its luteinizing effect on the ovaries of the immature animals. The result of the injections of the urine extract is shown in Figures 1 and 2.

Serial sections were made of the internal organs of generation of these immature animals and also of the internal organs of a test animal (No. 1527) that had died after aborting from the injections of the urine extract. In all cases the ovaries showed a luteinization of all follicles to form a compact lobulated mass

Near the centers of many follicles ova could be seen, surrounded by lutein masses (Fig. 3)

The results of these experiments are consistent as far as the effects of the two different materials used are concerned and the interpretation of both results is offered as follows

As soon as the injections are made, it is probable that stimulation of the follicular apparatus begins, to be followed by the luteinization process. Since about 4 days are required for the fertilized ovum to pass down the tube and arrive in the uterus it may be that the formation of lutein cells has advanced far enough to elaborate sufficient progesterone (Corney and Allen) to take care of the embedding and subsequent nourishment of the early ovum by the time it reaches there. If this is the case, it accounts for the failure of the injections to prevent conception.

The termination of pregnancy may be attributed to the production of estrin by follicle stimulation, for as shown by the work of Parkes and Bellerby, Margaret Smith and the present author, injections of estrin in sufficient amounts brings normal pregnancy to an end. It is true that Dolsy and his co-workers (8) have shown that a highly purified preparation of estrin had no detectable effect on the length of the gestation period of albino rats, but this needs to be confirmed for the guinea pig. It should be remembered that Margaret Smith was unable to terminate gestation in the albino rat after the fifth day with as high as 80 rat units. The fact is that pregnancy was terminated in the present experiments by the injection of preparations that produced a marked terminal luteinization of the ovaries.

If the observation of Dolsy and his co-workers just mentioned (that pure estrin does not terminate pregnancy) is true it must be considered possible that some other element in the injected material may have been the causative agent in terminating the pregnancies. So in this instance the abortions may have been due to some extraneous substance in the extracts.

It is worthy of mention that in terminating pregnancies in the guinea pig with estrin that there was a very high mortality of animals in the second half of gestation whereas in the present experiments, the mortality after abor-

tion from the urine extract at all stages of pregnancy was quite low. The inference is that the hypophyseal hormone did not upset the balance between the estrin and corpus luteum necessary for the dilatation of the pelvic ligaments of the guinea pig (Hisaw), so that the mothers did not die from sapraemia on account of retained dead fetuses as suggested by the author (6) in reporting the former work.

SUMMARY

Experimental findings show that injections of freshly expressed juice of the anterior lobe of bovine hypophysis or of extract of hypophyseal like hormones from the urine of pregnant women into sexually mature female guinea pigs do not prevent conception when administered in serial daily doses beginning the day of copulation but do cause abortion when given in a like manner to animals in any stage of pregnancy.

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CLINICAL SURGERY

FROM THE LEYSIN INSTITUTE OF HELIOTHERAPY

HELIOOTHERAPY AND ORTHOPEDICS IN SURGICAL TUBERCULOSIS

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THE systematic application of sunlight in the treatment of tuberculosis of bones and joints has enabled us to bring about a rational procedure with the object not only to treat the lesion but also to build up the general health of the patient. Although heliotherapy carefully applied according to the rules of precise dosage and of careful technique, may overcome all local effects of surgical tuberculosis it does not in itself correct deformities or overcome bad posture. We have found it wise to abandon the use of operations that maim and thus enfeeble the patient's resistance, that may aid the distribution of Koch's bacillus, and that often open the door to serious secondary infection. We have been led definitely to abandon the use of the large plaster apparatus, whether rigid or not, as we believe that its use is a great mistake from the physiological and orthopedic standpoint. Such apparatus keep the affected parts from contact with the air and sun, soften and produce atrophy of the skin as well as of the underlying muscles and bones with the result that decalcification caused by want of light is added to that produced by the tuberculosis of the bones.

We have replaced the closed plaster cast with a very simple arrangement for fixation and extension, the aim of which is to provide for the affected joints a sufficient degree of immobilization and at the same time to expose them freely to air and sunshine. We have worked out for each part affected a suitable orthopedic arrangement.

As immobilization in the lying position is necessary in the majority of cases, we shall say first a few words in regard to the bed that we use, for the bed constitutes, so to speak, the touchstone of the treatment. Its construction is very simple: the width is 75 centimeters, while the length varies. It is furnished with large wheels mounted on ball bearings which allow the nurse to move the patient without exertion or jarring. The spring mattress is formed of strips of metal with wide spaces to ensure permanent airing of the mattress. The

mattress is always flat, very hard and of uniform consistence. It has the advantage of remaining always dry; a soft mattress more or less wrapped round the lower parts of the body prevents the evaporation of perspiration and thus leads to softening of the skin and the formation of bed sores. To protect the head of the patient during sun treatment a shade made of linen supported by a movable stem, can be fixed to each bed and its position changed as desired. The construction of the beds has also been modified to meet the requirements for the treatment of the part affected.

POTT'S DISEASE

In all cases in which the vertebral column is affected we prescribe rest in the lying position. Patients affected with Pott's disease, who have no deformity and have good muscular development, simply lie upon the hard mattresses without pillows. But if the patient—and this is the most frequent type of case—reaches us in a state of advanced emaciation and with atrophied muscles, it is absolutely necessary to maintain the proper curvature of the spine, and pillows filled with millet are used: another pillow supports the scapulae and the spine. When Pott's disease is associated with angular curvature, we try to bring about reduction by applying slow and progressive pressure which is exerted purely by the weight of the body. A pillow stuffed with millet is placed under the kyphosis; later one of sand and the thickness is gradually increased. At first the pillow should be of somewhat yielding consistence so that the curvature is supported over its whole surface. In this way the formation of scoliosis, which would result from lateral pressure exerted upon the curve, is avoided. When, however the curvature becomes distinctly less and the skin becomes less sensitive, we replace the sand pillow with a rectangular block of wood, the thickness of which is adapted to the part of the body under which it is to be placed and to the size of the curvature. This has an advantage over the

sand pillow in that it retains its shape and remains completely smooth and dry, two indispensable points in avoiding bed sores which are apt to be caused by moisture and creases. Patients become accustomed quickly to this block and find in it more comfort than in the pillow. When pains have completely disappeared, and from the time that radiography shows the development of vertebral consolidation, we encourage the patients to assume the ventral position. This is the best physiological position, for, by means of exposure to the sun, it provides for restoration of the muscles of the back and thus furnishes the patient with a veritable muscular corset which is the ideal and rational support for the vertebral column. The three pillows used in the dorsal position are now replaced by a single very hard triangular pillow which is slipped under the thorax in order to accentuate the lordosis of the dorsal spine and thus to aid in correcting the dorsal and lumbar curvatures. In cases seen early, this position helps to prevent subsequent deformities of the spine. The patient lying upon the stomach has a tendency to throw back the head in order to look in front of and around him, and he thus increases the physiological lordosis. The movements of the body produced in this way are admirable exercises, as they bring into play the muscles of the scapula, humerus, and dorsal regions—movements which are in no way dangerous, since the vertebrae are not burdened with the weight of the body. The ventral position, in fact, contributes by the pressure exerted upon the abdomen, toward regulating the functions of the bowels. The patients also prefer this position they become used to it after only a few days of training and in it spend the greater part of the day and sometimes even of the night. Lying upon the stomach they can undertake light manual work, such as writing drawing wood carving thread work, and typewriting. In Pott's disease with sinuses, the wounds and sinuses, exposed in this way freely to the action of the sun, dry up much more quickly than under any other method of treatment.

In Pott's disease of the cervical spine we use an extension arrangement which exerts pressure only upon the occipital region. A molded celluloid headpiece rests upon a wheeled carrier moved by an extension weight, thus all the region of the chin is free from pressure. The neck region also is freely exposed to the air, any cold abscess or sinus is controlled very early and the sun has free access to it. This treatment again builds up all the muscles of the affected region, patients recover with complete mobility of cervical spine.

The roentgenograms in cases of Pott's disease treated by heliotherapy are very striking. By them we can follow the course of repair as the vertebrae become progressively hardened, the vertebral blocks becoming solid and often supported by the calcification of a peri-focal abscess, the calcification acting like the nuts which bolt together two pieces of metal.

From the clinical standpoint, the progress of the cure is also interesting to witness. In spite of the fact that the greater number of patients with spinal tuberculosis come to us affected with cervical dorsal, or lumbar vertebral disease the process often affecting several parts of the spine, and in spite of the fact that the patients almost always are wasted by having worn plaster apparatus and present angular curvatures, large or small, within $1\frac{1}{2}$ or 2 years—seldom more—they are completely transformed. Their bodies have become uniformly developed, their muscles are powerful, their deformities are corrected at least partially, by means of a compensatory lordosis above and below the curvature, the residue of the latter being partly hidden by the splendid muscles. It is easy to understand that such robust patients are thus prepared by the work cure to take up normal activities once again.

We have never used the bone graft, for we believe that this procedure prevents or hinders the formation of the vertebral block which is the natural process of cure that is so obviously helped by heliotherapy.

HIP JOINT DISEASE

For disease of the hip we have always been in favor of continuous extension which is carried out by means of strips of plaster which are fixed along the sides of the thigh, so as to avoid compression of the knee and so as to leave the greater part of the skin uncovered. By means of heliotherapy the muscles are always preserved they often develop to such an extent that it is difficult to distinguish between those of the affected and the healthy limb. The groove on wheels which we employ to support the affected limb keeps the limb in good position and maintains effective extension by means of small weights. The patient is kept in the rational position, that is, the central part of the body is raised by means of a pillow stuffed with millet, so that the pelvis becomes the highest point of the body. This procedure permits easy correction of faulty positions and helps to prevent their formation. Moreover, bed sores and their later serious consequences are prevented. A further advantage is that we are able to control, by means of the traction exerted,

the immobilization of the patient in a manner that is at once necessary and sufficient, for the immobilization becomes less rigid in proportion as the inflammatory symptoms grow less and disappear.

When faulty position of the hip is associated with a tendency to pointing of the foot, we use a special band which is furnished with an elastic band along the tibia. This band stretched more or less according to the amount of pointing does not in any way prevent movements of the foot, but it does bring the foot back to normal position.

In hip disease especially if there are sinuses situated toward the front of the thigh the lying position sometimes hinders the escape of purulent secretion. Therefore, in order to encourage drainage we have found it necessary in some former cases in which amyloid degeneration complicated or threatened the progress to get the patients out of bed before cure of the bony lesion was completed for the drainage of the pus in such a case is of immediate importance. By means of this change of position we have often succeeded in facilitating the evacuation of the pus and as a result, intoxication has been arrested, the temperature lowered and both the general and local condition of the patient correspondingly improved.

In the majority of our patients with tuberculous disease of the hip the roentgenograms taken on the arrival at the hospital show an osteo-arthritis in full activity and the acetabulum the head and even the neck of the femur show in general a definite disintegration which is represented in the photograph by a soft shadow which completely blurs out the contours of the joint. In the midst of this chaos in time a new head makes its appearance. Its contours, as well as those of the acetabulum, become more definite while the parts affected by atrophy become the seat of an intensive recalcification. In certain cases the head of the femur partly destroyed has broken through the osseous edge of the acetabulum, and we can see the progressive reformation of a new joint cavity the opening is obliterated, the head of the femur is reformed to such an extent that the trabecular structure is outlined with large meshes—an obvious sign of intensive calcification. In this way new joints are formed between the acetabulum and the new head of the femur thus producing a degree of functional adaptation which could hardly have been hoped for. The frequency of this occurrence (in 85 per cent of cases) is in fact one of the special features obtained by heliotherapy in the treatment of tuberculosis of the hip. This adaptation is brought

about not only by the reconstruction of the joint but also by the restoration of the muscles in the thigh the muscles commence again to play their part as mechanical structures, indispensable to the function of the joint.

The prognosis in hip disease is equally as favorable as it is in Pott's disease the results are as good in the adult as in the child and even when the osteo-arthritis is closed, the presence of sequestra in the acetabulum—a not infrequent occurrence—is not necessarily a complication for the sequestra almost always become reorganized and do not in any way obstruct the function of the joint. It is very interesting to watch in the roentgenograms how the reorganization of these sequestra is effected by the intermeditation of small trabeculae which reunite the larger one in the cavity of the acetabulum. When secondary infection is present the spontaneous elimination of necrosed sequestra often occurs as it does in osteomyelitis. We resort to sequestrectomy only in the presence of sequestra *en gros* and this procedure carried out always during the period of repair is not as some have stated an enticement to recurrence. Experience convinces us to the contrary. When there is not only restoration of function of a joint but a good clinical recovery especially when the roentgenograms show recovery even though this is only partial the circulation, and therefore the local power of defense, is aided much more than if ankylosis had been brought about, for ankylosis by inactivity encourages the atrophy of bone and muscle. Recurrence more often follows in hip joints which have been ankylosed for some time than in hips which have been kept movable by heliotherapy provided the patient has quitted Leylan only after his radiographic areal.

TUBERCULOSIS OF THE KNEE

In the treatment of osteo-arthritis of the knee we combine heliotherapy with extension of the leg. This procedure has the advantage of avoiding compression and ulceration on the articular surfaces and, by supporting the leg, helps to a large extent in bringing about a return of functional movement. In all cases the leg is placed upon an inclined plane to increase the return circulation. We attach great importance to this rational arrangement.

In cases complicated by dislocation of the tibia we use in addition to extension, suspension of the leg by means of elastic bands from a hoop placed like a bridge above the leg. The weight of the leg helps to correct the faulty position so that one is never obliged to resort to forcible reduction. If

there is also present a lateral displacement we add traction in the direction opposite to the displacement by means of cords attached to weights. The joint remains always uncovered and thoroughly exposed to the sun's rays.

When the osteo-arthritis, almost always painful is complicated by infiltration around the joint, by abscesses or by sinuses, giving the joint the appearance of a white spindle heliotherapy is of special value because it acts in many ways to correct the condition. Heliotherapy at once possesses determinant, soothing, bactericidal, resolvent, and hardening powers. Pain abates and disappears the parts which are stretched and hard, and shine with smooth atrophied skin, become soft and pigmented, diffuse infiltration lessens and disappears the outline of the knee cap shows itself anew and the muscles, which up to now have been flabby and atrophied, resume their true shape. The roentgenograms which are taken at the beginning bear witness to the seriousness of the condition of these bone and joint conditions in which the tissues are dissolving into caseous and purulent material they show the ulceration of the articular surfaces often associated with secondary infection. In some cases the caries of the bone has given place to the formation of large sequestra, all show the classic thickening of capsular infiltration or fungus degeneration.

Progressive roentgenographic examination of the bone and joint make clear the reconstructive action brought about by heliotherapy. The films show the demarcation and progressive hardening of the foci, the reappearance of bony structure with thick trabeculae in the blur of caseous disintegration, the reorganization of the sequestra and the reformation of the joint surfaces which are demonstrated by the presence of a new joint space. In the same proportion as bony regeneration takes place, the thickening of the capsule abates and disappears, in fact in some cases recovery takes place to such an extent that without exaggeration the joint may be said to be *restitutio ad integrum*. It is easy to understand that in such conditions the functional recovery of the joint is not at all extraordinary. Just as in the case of hip disease this does not produce any risk of return when the radiographic recovery has been attained. Functional recovery is always spontaneous and we never seek to contribute to it by untimely movements, either active or passive for such movements are always prone to produce relapses.

Nature herself acts with such discernment that when she judges it right to produce ankylosis (and

this is the exception) we take care not to interfere and we bow to her decision. Age has no unfavorable influence upon the return of function in the joint, for we have seen restoration of function in patients of 60 and even 70 years (thesis of Dr. Miéville). Some roentgenograms which show foci in the form of cavities which are near the epiphyses and are of considerable size and which may affect either the femur or the tibia, show after demarcation the reappearance in the foci of new bony structure which fills up the cavities and gives to the bone an apparently normal aspect. When sequestra lie in these cavities they become organized without difficulty and help to check the process. We have never been forced to operate in such cases, although some such patients had already been operated upon without success. The possible saving of time does not compensate for the risks involved in operation and the danger of secondary infection which is very great in operations in the immediate neighborhood of the knee joint. A fact which deserves to be mentioned is that when heliotherapy is used in treatment of tuberculosis of the knee it often preserves the movement of the joint but it may also bring about the desired ankylosis when an excision has unfortunately been followed by pseudo-arthritis. In support of this statement we may mention a number of cases in which the patients were admitted to Leyva after excision and who were affected by secondary infection and numerous sinuses 16 in 1 case 13 in another and 11 in a third. These patients had pseudo-arthritis with stiff knees, but all recovered with ankylosis after all the sinuses had dried up and cicatrized.

TUBERCULOSIS OF THE FOOT

Of all the joints the tibiotarsal is the one which gives the most favorable results both from the point of view of curability and from that of restoration of function. In only one other joint are the results more favorable and that is the wrist.

Immobilization in a groove, which leaves the leg and the joint in constant contact with the air and light and elevation upon an inclined plane constitute, as they do for the knee, the chosen method. Pointing of the toes is corrected or prevented by a sandal joint to the groove. Our apparatus, by mild and progressive traction which is easily regulated prevents atrophy of muscles and favors the formation of the new joint and the return of joint function. Even when the osteo-arthritis is complicated by secondary infection and even when there is extensive destruction of bony tissue, recovery in good position and restora-

tion of function, more or less complete is the rule. We have never had to excise or remove the astragalus—procedures which we regard as a last resort and which are always avoidable if helio-Alpine treatment is used.

Moreover we have treated numerous cases of disease in the tibiotarsus and metatarsus, of such great extent that amputation of the foot had been considered inevitable, but the patient made such perfect recovery that the affected foot could hardly be distinguished from the healthy one. Radiographic films showed that the joint surfaces which had previously been ulcerated or completely destroyed by the caries were healed and sound.

ARTHRITIS OF THE SHOULDER

In arthritis of the shoulder we seek to fix the arm in slowly progressive abduction, by means of a hinged apparatus with notches which allows the gradual separation of the arm from the side, and upon which the extension is fixed. This arrangement, which allows free access of the sunlight to the joint, prevents bad position of the arm in relation to the scapula and the loss of compensatory movement of the whole shoulder. It is a well known fact that in this joint more than in any other weakness corresponds to muscular inefficiency and that osteo-arthritis of the scapula is associated with atrophy of the shoulder muscles. In this as in all joints, heliotherapy not only checks the development of the most extensive destructive processes in the head of the humerus and in the glenoid cavity and completely remedies the defects, but it is also an admirable restorative to the scapulohumeral muscles and greatly helps the return of functional movement. We have never had to resort to excision. The duration of treatment is about 14 months (12 in simple cases of tuberculosis 16 in osteo-arthritis complicated by secondary infection).

TUBERCULOSIS OF THE ELBOW

For the elbow joint, we use a double groove or a double jointed splint which can be fixed as desired. We endeavor above everything else to bring back the joint to a right angle and maintain it there. Under the action of sun treatment there takes place complete repair of the foci of osteo-arthritis, regeneration of cartilages more or less destroyed, absorption of infiltrations around the joint, and the disappearance of fibrous adhesions. The restoration of the muscles, which is usual, is a great help here as elsewhere, in the return of function which frequently takes place in the presence of tuberculosis of the elbow even when secondary infection complicates the condition.

In a recent study of a series of 31 cases of osteo-arthritis of the elbow observed in our clinics, one of our assistants (Dr. Miféville) found that 24 had suffered from sinuses on their admission of 22 cases of osteo-arthritis 8 left. Leyman cured and with normal function, 9 with reduced function, and 5 with ankylosis, in 12 other cases of suppurating arthritis with sinuses, 6 recovered with complete function, 4 with a range of movement from 30 to 70 degrees, 2 with very limited movement.

TUBERCULOSIS OF THE WRIST

Osteo-arthritis of the wrist is treated by immobilization upon a plane combined, according to the case, with extension by means of strips of plaster fixed to the fingers and provided with elastic that can be stretched as desired and fixed under the apparatus. The apparatus is attached by two leather straps passing one across the hand and the other across the forearm the hand the wrist, and the forearm thus remain uncovered.

Heliotherapy of tissues of the wrist gives most favorable results, and recovery is always accompanied by return of function. Our results, and those published by our former assistant (Dr. Huxey) show the preservation of the functional integrity of the hand. These results are essential both for aesthetic and social reasons. It is indeed one of the chief advantages of heliotherapy that complete restoration of a joint is accomplished while the classic excision sacrifices the joint.

TUBERCULOSIS OF THE HAND

Tuberculosis of the metacarpus and phalanges is treated by immobilization upon a small splint combined with extension effected by means of a very simple arrangement. The sun cure in these cases, as in those of spina ventosa, produces equally favorable results. Radiography shows *restitutio ad integrum* in both the anatomical and functional sense is almost always the rule prior to secondary infection. Even when the latter has occurred to complicate the case, new joints form without any functional difficulty. Metacarpal bones or phalanges on the road to caseous break down or even partly destroyed by caries recover their structure so completely that when the cure is complete the structure appears much more dense than that of neighboring metacarpals and phalanges.

COLD ABSCESSES AND SINUSES

We cannot conclude this chapter on tuberculous disease of bones and joints without saying a few words regarding our method of treating cold abscesses and sinuses.

The formation of the cold abscess is one of the natural phases in the process of treatment of osteo-articular tuberculosis. We regard the cold abscess as a favorable reservoir of antibodies which contributes in large measure to immunization. From the time that the restoration of the 'soil' commences under the action of heliotherapy, the bacilli of Koch lose their virulence in it little by little, and the cold abscess is simply a small laboratory where the immunizing bodies are developed. Because we attribute this therapeutic rôle to it, we deprecate its premature puncture. The contents of the cold abscess are in our opinion pre-eminently 'good and laudable pus.' Such abscesses are always inoffensive, never produce fever, and one has only to recognize the haste with which the organism seeks to refill an abscess prematurely opened in order to understand the importance attached to this by the *natura medicinalis* in its process of cure. Under the action of heliotherapy and in proportion to the state of improvement of the 'soil' the cold abscess is absorbed or calcified. We often see cold abscesses arising from bone in the case of tuberculosis of the lumbar vertebrae which are so voluminous that they partly fill the pelvis, or abscesses arising from disease of the ribs which stretch out like wallets along the back, and yet these are absorbed completely during the sun treatment without the curve of temperature showing an elevation by even the tenth of a degree.

In tuberculosis of the knee, for example, the appearance of a cold abscess is always a sign of good omen and indicates the commencement of cure in the course of treatment. Pott's disease is associated as a rule with a large or smaller cold abscess which is absorbed spontaneously or calcified, forming thus around the vertebral fusion a structure resembling a set of supporting bolts. These abscesses are inaccessible to the trocar and this is perhaps the reason why they are able to develop so favorably. If cold abscesses in the dorsal region are allowed to develop without puncture, why should one attack those of the lumbar region which are accessible? In puncturing cold abscesses not only does one take away their immunizing properties but what is of more importance the door is opened for secondary infection. Infection proceeds to develop as it would in the best culture media, and becomes all the more formidable in that there remains no time for local defensive mechanism to oppose the obstacles which may limit the area of infection.

These are the reasons that have led us to advise against puncture and rather to assume a prudent

attitude of expectancy, so long as the development of a cold abscess takes place normally. When its helpful rôle of immunization appears to be ended and when, instead of proceeding toward absorption it seems to be attempting to discharge through the skin then puncture is urgently called for and should be repeated until all danger is removed. Often, on the arrival of a patient for treatment, perforation of a cold abscess is imminent. If the skin has already become too thin and changed to be punctured and if rupture is inevitable, the affected area should be prepared for spontaneous perforation by the application of antiseptics (compresses of alcohol) and this measure of precaution should be continued until the sinus is closed, for above all it is necessary, if possible, that secondary infection be avoided.

The presence of this formidable complication, we cannot repeat too often, changes altogether the prognosis in surgical tuberculosis. While the progress in a closed case of surgical tuberculosis treated by heliotherapy is favorable both in children and adults and in any locality, its development may become capricious when a secondary infection complicates the picture. A study and comparison of the temperature charts in these two categories of patients emphasizes this point—the curve in the closed cases of surgical tuberculosis shows a most monotonous regularity, while that in the open case is irregular and broken like the lines of an Alpine panorama. In infection with staphylococci or streptococci there is formed a new microbic flora which soon predominates the clinical picture—the development of the infection is speedily manifested by formidable fluctuations, interminable suppurations, retentions, septicæmic fever, intoxication, and amyloid degeneration. The contrast is striking between the appearance of patients affected by closed tuberculosis and open infection—in the former the patient has the color of health and shows a generally flourishing state with muscles that are often athletic while in the latter the patient is pale, often has an earthy complexion, flabby muscles, febrile appearance, and recovery is most difficult to attain.

It is well, however, to recognize that there are different categories of cases, all are not equally serious. A sinus, for example, upon a finger or upon the olecranon may be relatively benign if the focus of disease communicates directly with the opening in the skin and offers no possibility of retention. When, on the other hand, a focus is situated in the vertebral column and the pus makes its way along the psoas muscle to end in a sinus in the upper and inner part of the thigh, it

is easily understood that on this long passage with much burrowing septic retention is easy and absorption by the surrounding tissues will cause serious intoxication.

In tuberculosis of the pelvis, for example of the sacro-iliac joint heliotherapy usually brings about cure in about a year provided the tuberculosis is closed and even when a cold abscess has been present. On the other hand the pelvis becomes one of the most troublesome sites when spontaneous rupture or a cut by a scalpel, or an unfortunate curettage has introduced secondary infection into a benign cold abscess. The infection becomes entrenched in the deep and inaccessible windings of the sacro-iliac joint and there follows deep retention and suppuration that cannot be dried up. Surgical intervention, when not urgently indicated, alters the organization of the local defense and provides access to secondary infection. Calot has said that "to open a case of tuberculosis is to open a door by which death will too often enter."

The treatment of secondary infection demands special therapy and technique. First, effective drainage for the fistulous passages should be secured, for the success of treatment and the life or death of the patient will depend upon the possibility of securing discharge from the sinuses. It is of first importance to avoid premature closure of the passages. If insufficient, one can dilate the opening with the help of tents and introduce into it drainage tubes of sufficient length to prevent superficial closure. Local heliotherapy is abandoned in favor of general heliotherapy the doses of which must be cautiously determined depending upon the reaction as indicated by the temperature curve. While it is a serious mistake to incise a cold abscess, wide and early incision of a warm abscess is a wise step to insure sufficient drainage and to eliminate septic retained material.

One should not labor under the impression that antiseptics have great bactericidal action for antiseptics sometimes exercise an action which is prejudicial to the vitality of the tissues rather than detrimental to the germs. If antiseptics are absorbed along with toxins they may act as a

contributing factor in impairing the vitality of the kidneys. We have recourse only to the less harmful such as gomenol tripaflamine, diathrene, or thiorubrol but their action is not sufficient to control secondary infection. In some cases, to help drainage we have employed with success continuous drainage by siphon with weak Dakin's solution or with physiological salt solution. While none of the monovalent or polyvalent vaccines recommended by so many authorities has given us any appreciable results, we have had very interesting experiences with sulphur baths (baths of Schlimmich and of Lavey in Switzerland). Once the cleansing has been effected and regular drainage assured, the sun cure is then able to exert its beneficent action.

Let us say one word finally regarding the influence of heliotherapy upon sequestra. Roentgenograms of bones and joints with closed tuberculosis show in a very precise manner how the sequestra dissolve and become absorbed or more often become organized and incorporated with the living tissue, so that they cause no trouble in the functional recovery of the joints. In some negatives we can follow the progress of complete elimination of necrosed sequestra (it is characteristic of secondary infection that the sequestra become necrosed as in osteomyelitis).

Nature is able better than the surgeon, to distinguish between the healthy tissues intended to be preserved and the tissues which are irretrievably affected and are destined to be eliminated. Roentgenography shows admirably the stages in this process of demarcation. Thus we regard as useless interference by hasty or premature operations which risk, so to speak, stirring up an ant heap with a stick, and we maintain an expectant attitude so long as nothing interferes with the spontaneous elimination of a sequestrum. On the contrary we intervene without hesitation when the sequestrum is *en passe* just as we do when the sequestrum is *ex griot*. After sequestrectomy has been effected the resulting cavity is treated with heliotherapy and open air which help to bring about cicatrization and at the same time avoid secondary infection.

FROM THE LAHEY CLINIC

A METHOD OF DEALING WITH THE PROXIMAL JEJUNAL LOOP IN POSTERIOR PÓLYA ANASTOMOSIS

FRANK H. LAHEY, M.D., F.A.C.S., BOSTON

THE following plan of management in posterior Pólya anastomosis of the proximal loop of the jejunum to the gastric stump after partial gastrectomy has proved useful and satisfactory in our hands. Others very probably have employed the same plan, although I have not seen it used or described. While I am not interested in claiming priority concerning this plan, I do wish to describe it because I trust that it may prove as useful to other surgeons as it has in our clinic.

Following partial gastrectomy, connection between the small intestine and the stomach may be re-established by a variety of methods, one of the most popular of which is the end-to-side anastomosis of the jejunum to the open end of the resected stomach, an operation which, in this country, is called the Pólya operation.

Various plans and modifications of this procedure have been practiced. Donald C. Balfour has suggested that a loop of jejunum be brought up over the transverse colon and anastomosed to the cut end of the stomach—the antecolic Pólya anastomosis. This plan has proved very useful, but it has two possible drawbacks. Occasionally in attempting to carry out this step, I have found the length of the jejunal mesentery so short that when it is brought up at a reasonable level over the transverse colon to reach the cut end of the stomach it produces such pressure upon the transverse colon that, were distention to occur in that structure, there would be danger of obstruction. It is true, however, that in a large percentage of the cases, the jejunal loop can readily be approximated to the stomach without difficulty so that this plan has been accepted as very useful. The second possible drawback is, in order that the jejunal loop will reach over the transverse colon a long jejunal loop must be used, thus resulting in the dumping of gastric contents into a relatively low segment of the jejunum. In all probability this criticism is not serious but, other things being equal, an endeavor should be made to approximate the stomach to the small bowel as near to the duodenum as possible. It must be assumed that the farther from the duodenum the point of anastomosis between the stomach and jejunum be made, the less adapted that segment of bowel

will be to receive gastric contents and the greater will be the likelihood of recurrent gastrojejunal ulcer at the suture line.

I have always been inclined to use the posterior Pólya type of anastomosis, passing the loop of jejunum through the transverse mesocolon, thus permitting the anastomosis of the jejunum to the cut end of the stomach at a level somewhat closer to the duodenum. In this manner the occasional difficulty with a short mesentery to the jejunum is avoided and approximation to the cut end of the stomach is made easy. I do not describe the plan here submitted as an argument against the antecolic Pólya plan of anastomosis but rather that it may be available for those who are interested and wish to employ the posterior Pólya type of procedure.

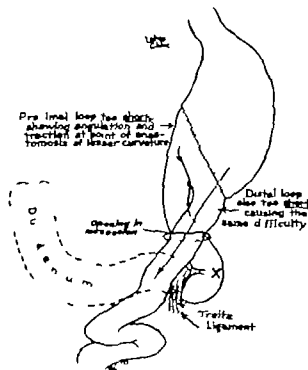


Fig. 1. This diagrammatic figure demonstrates that when an insufficient amount of proximal jejunum is utilized and the stomach is permitted to drop back into the left upper quadrant, traction occurs on the suture line due to the short proximal jejunum. The disadvantage of too short a distal loop of jejunum is likewise illustrated. Note the ligament of Treitz and that, by incision of this ligament, the proximal loop of jejunum may be transplanted above the mesocolon.

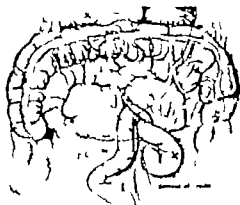


Fig. 2. Drawing showing the angulation of the jejunum if the proximal loop is carried up through the mesocolon and the ligament of Treitz is not severed; also the double barrelled effect of proximal and distal loop of jejunum as they pass through the rent in the mesocolon. Even if the mesocolon is sutured to the gastric stump, as is frequently done, considerable angulation of the proximal jejunum results. Note the ligament of Treitz, which in the plan here described, is to be incised, thus permitting the displacement of this proximal loop of jejunum through the mesocolon so that it runs above it. Then but a single loop of jejunum, the distal one, emerges through the rent in the mesocolon. Note the level of the proximal jejunum marked *x* in order that it may be compared with this point when transplantation has been done above the transverse mesocolon by the plan described in the text.

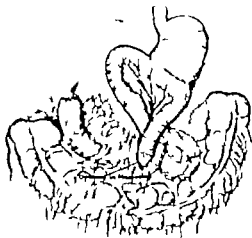


Fig. 3. This figure is the same as Figure 2, except that the relations above the mesocolon with the transverse colon turned down are seen. The angulated proximal loop of jejunum is shown below the mesocolon in dotted lines.

Note again the point marked *x* in the proximal jejunum beneath the transverse mesocolon.

In the posterior Pólya type of anastomosis in partial gastrectomy one of two plans may be employed in dealing with the proximal and distal loops of jejunum. After the end-to-side anasto-

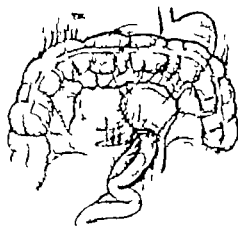


Fig. 4. After incision of the ligament of Treitz and transplantation of the proximal loop of jejunum, the single loop of distal jejunum emerges from the opening in the transverse mesocolon. The mesocolon has been sutured above the single loop of jejunum. The transverse colon is turned up so that the proximal jejunum is shown in dotted lines, indicating its position above the transverse mesocolon. Note now the position of *x* well above the mesocolon and as relates to the level of the jejunum at which the anastomosis has been made.

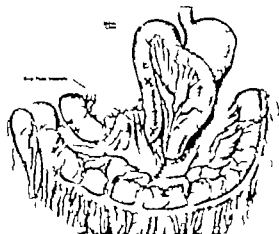


Fig. 5. This figure is the same as Figure 4, except that the transverse colon has been turned down in order that the proximal and distal loops of jejunum may be viewed from above the mesocolon. Note the rent in the mesocolon sutured. One side of this rent represents the incised ligament of Treitz. Note the point *x* on the bowel now well above the transverse mesocolon, the lack of angulation and that more than enough proximal jejunum has been utilized in order to prevent traction and angulation when the stomach retracts into the left hypochondrium. Note also that but a single loop of jejunum, the distal loop, passes through the transverse mesocolon.



Fig. 6 Gastro-intestinal tract after partial gastrectomy and Pólya anastomosis by the plan here described. The patient was first given a bismuth enema to demonstrate the position of the colon and then bismuth by mouth to demonstrate the relation of the proximal and distal loops of the anastomosed jejunum to the bismuth filled colon and mesocolon. There are several interesting points in these pictures. The distal loop of jejunum is long and angulated at the point marked *x* where it passes as a single loop through the mesocolon. The proximal loop of jejunum is unfilled with bismuth in both pictures. The caliber of the end to-side anastomosis between the large transversely cut end of the stomach and the small intestine eventually becomes of quite moderate size.

Fig. 7 Bismuth was given by mouth only, the bismuth enema being omitted. This permits clear visualization of the bismuth filled distal loop of jejunum, and clearer demonstration of the above-mentioned points. Again note part *x* where the distal loop of jejunum passes through the mesocolon, and the single loop of jejunum passing through the mesocolon and the proximal jejunum unfilled with bismuth.

mosis between the jejunum and stomach, one plan is to suture the slit in the transverse mesocolon anteriorly and posteriorly to the stump of the stomach itself thus placing the proximal and distal loops of jejunum entirely below the transverse mesocolon in the general peritoneal cavity. A disadvantage of this method is that if the gastric resection be high and the gastric stump short, it will be difficult to bring the transverse mesocolon up high enough so that it can be sutured to the gastric stump without distortion of the transverse colon. In some very high gastric resections, in our hands, it has proved impossible.

The other plan customarily employed is to bring both loops of jejunum up through the transverse mesocolon, to permit the stomach to retract to its natural height, and then to suture the rent in the transverse mesocolon about the double barrelled loop of proximal and distal jejunum (Fig. 2). The disadvantages of this procedure are that the jejunum must emerge from its retroperitoneal position in the jejunal fossa, the afferent loop must

ascend through the slit in the transverse mesocolon and the efferent loop must also emerge through the transverse mesocolon, thus producing a double barrelled effect with considerable angulation of the loop of proximal jejunum. Another undesirable factor in the plan is that it is not possible satisfactorily and accurately to close the opening in the transverse mesocolon when two loops of jejunum pass through it.

By the plan we have employed and here suggest, an opening is made in the transverse mesocolon usually just to the left of the root of the ligament of Treitz. In some measure the site of the opening in the mesocolon must depend upon the location of the middle colic artery. Through this aperture there is passed a loop of jejunum which is sufficiently long so that when the stump of the stomach retracts upward into the left hypochondrium, there will be no undue traction and tension upon the point where the proximal loop of jejunum is attached to the cut end of the stomach at the point which marks the lesser curvature. I

wish particularly to warn operators who are not familiar with this step that, in order to avoid tension as here described, the proximal loop of jejunum must always be a little longer than at first seemed necessary. This is extremely important, since if the end-to-side anastomosis has already been made and following release of traction upon the stomach and the ascent of that organ there is tension on the upper angle of the suture line due to too short a proximal jejunal loop a dangerous and distressing situation arises (Fig. 1).

Having satisfactorily completed the posterior Pólya anastomosis, the plan which I have employed and wish to describe is as follows:

The ligament of Treitz is cut from its lowest insertion into the jejunum, up to its origin in the mesenteric root. This permits of mobilization of the uppermost part of the jejunum, so that the proximal loop of jejunum now anastomosed to the stomach can be passed up through the slit made in the transverse mesocolon, and in this way the entire proximal loop of jejunum is brought above the mesocolon and is excluded from the greater general peritoneal cavity. While the true vascular root of the transverse colon is still above the junction of the jejunum with the duodenum nevertheless there is less angulation

of the proximal jejunum than when the proximal jejunal loop enters the greater peritoneal cavity at the jejunal fossa and is again passed upward out of the greater peritoneal cavity through a slit in the transverse mesocolon. It has the additional advantage that now but a single segment of bowel, the distal jejunal loop emerges through the transverse mesocolon (Figs. 4 and 5). Snug suture of the slit in the transverse mesocolon about the single loop of bowel is thus possible and the danger of hernia through this slit is lessened.

The plan of the placing of the entire proximal loop of jejunum above the transverse mesocolon in a posterior Pólya anastomosis has, if anything not added to but diminished certain of the technical difficulties of this type of anastomosis after partial gastrectomy. In all of the cases in which it has been employed, the anastomosis has functioned well and any question of the need of entero-enterostomy between the proximal and distal loops of jejunum has been eliminated.

The plan submitted has proved valuable by actual repeated employment. It is not suggested that it be employed in preference to other methods but it is hoped that it may prove useful to those who like and employ the posterior Pólya type of anastomosis after partial gastrectomy.

RENAL TUBERCULOSIS

DIAGNOSIS AND TREATMENT, WITH STUDY OF NINETY-SEVEN CASES OF NEPHRECTOMY FOR TUBERCULOSIS¹

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From the Department of Urology (James Buchanan Brady Foundation) of the New York Hospital

THE frequency with which tuberculosis of the kidney occurs compels the general practitioner as well as the urologist to be constantly aware of its possible existence. It is estimated that 0.5 per cent of all surgical operations and 27 to 30 per cent of kidney operations are performed for renal tuberculosis. Great importance is therefore attached to renal tuberculosis in the field of urological surgery.

It has been said that by careful study and investigation an undiagnosed case of renal tuberculosis can be ferreted out in almost any large clinic. This is true because the subjective symptoms may be absent or so variable as to make the presence of tuberculosis unsuspected. At the present time however the diagnosis is more frequently made, partly because we are constantly searching for this disease but primarily because of the recent advances in the art of urological diagnosis.

It is not my intention to dwell on the many disputed points in etiology, pathology, diagnosis, and treatment these subjects have been so thoroughly discussed that a repetition would be superfluous. Moreover it seems to me that most of the debatable questions have been sufficiently solved to give us a firm foundation upon which to work. Much experimental and clinical evidence, by careful observers, has clarified many erroneous conceptions of renal tuberculosis. I do wish, however, to emphasize a few points in the diagnosis and treatment, most of which have been mentioned but which will, I feel stand repetition. These points are based mostly upon a study of 97 cases upon whom nephrectomy was performed for tuberculosis of the kidney in the New York Hospital between December 1914, and July 1932.

Until further convincing proof to the contrary is forthcoming we feel that some types of tuberculosis of the kidney will heal under certain circumstances. It is also our impression that tuberculous bacilluria without renal pathology does not exist, and that when such cases are reported the error lies with the pathologist. We believe too that removal of a kidney from which tubercle bacilli have been repeatedly recovered, without other clinical evidence is an error in judgment,

that genito-urinary tuberculosis almost invariably enters the kidney by the blood stream and secondarily affects the ureter bladder and genital tract, that bilateral renal tuberculosis occurs more often than was formerly believed and that in some patients, in whom bilateral renal tuberculosis has been diagnosed removal of the destroyed kidney offers the greatest hope of benefit to the patient.

We follow the general principles mentioned chiefly because of the excellent experimental work reported by Medlar Harris Uffreduzzi (quoted by Form 10) Helmholz (quoted by Braasch, 4) and others. These facts have also been fairly well established by many thorough clinical observers among whom may be mentioned Thomas (26), Braasch (3) Beer Stevens, Kretschmer Bumpus, and Wildholz. Together with our own observations we feel justified in assuming these general principles as a working basis subject to any unusual findings in a given case.

PRECLINICAL TUBERCULOSIS OF THE KIDNEY

Let us first consider the preclinical, or silent stage of renal tuberculosis. Harris, in his excellent experimental work, ably describes this stage by saying "Of the course of the disease from the onset of symptoms to its termination by operation or death one is thoroughly familiar but of the course of the disease from the time the first tubercle bacillus is implanted in the kidney until the involvement of the bladder gives rise to symptoms which attract attention to the urinary tract, nothing is known. He studied the urine of 43 adults and 67 children who had bone tuberculosis and obtained tubercle bacilli in 37 per cent of the adults and about 13 per cent of the children. Of these 68 per cent exhibited none of the usual symptoms of renal tuberculosis. Furthermore several patients, whose urine for a year or more showed tubercle bacilli and pus, are now free from symptoms and show no tubercle bacilli in the urine. He believes that this silent stage usually lasts for years. Herman (12) expresses the eventual outcome of some of these patients when he suggests that unilateral surgical (tuberculous) lesions represent the progressive remains of a



Fig. 1 Shows kidney partially destroyed by tuberculosis and with poor function. Note the infected glands just to the right of the fourth lumbar interspace on the left side. This kidney was removed almost 2 years ago. The other kidney (Fig. 2) was also infected with tuberculosis but was functionally perfect. With postoperative medical treatment patient is almost free from symptoms and has gained weight.

once disseminated infection," and, further (13)

In employing the term, primary renal tuberculosis, one refers to a state of primarity of the infection only in respect to the site of its initial appearance in the urogenital system." Hobbs, according to Stevens, found tubercle bacilli in the urine of 8 per cent of 422 patients, with no other symptoms. Bumpus and Thompson also reported 8 per cent of 345 patients who were otherwise symptomless yet had tubercle bacilli in the urine 23 of whom had had a tuberculous kidney removed, operation in the remaining 5 cases being deemed inadvisable. Thomas (26) states that many cases of renal tuberculosis go undiscovered and heal before destruction occurs. He has also found that no symptoms were present in the majority of cases with early renal tuberculosis.

It is our impression also that this preclinical stage of renal tuberculosis exists much more frequently than has been recognized in the past. We might ask ourselves the difficult question of how

TABLE I—AGES OF NINETY-SEVEN CASES UNDERGOING OPERATION

| Age in years | Number | Per cent |
|---|--------|----------|
| 1 to 20 | 11 | 11.4 |
| 21 to 30 | 37 | 38.0 |
| 31 to 40 | 31 | 32.0 |
| 41 to 50 | 3 | 3.1 |
| 51 to 60 | 5 | 5.2 |
| Youngest patient 12 years, oldest, 60 years, average age, 30.4 years. | | |

TABLE II—SEX OF NINETY SEVEN CASES UNDERGOING OPERATION

| | Number | Per cent |
|----------------------------------|--------|----------|
| Total operated upon | 97 | |
| Males | 59 | 52 |
| Females | 47 | 48 |
| Patients with postoperative data | 73 | |
| Deaths | 9 | |
| Males | 7 | 4 |
| Females | 2 | 4.2 |

such a condition should be suspected. Barnett states that positive diagnosis in an early case is difficult because the process has not yet punctured the mucous membrane. A. R. Stevens (quoted by Beer) points out that one cannot exclude a tuberculous focus in a kidney because one can prove that such a tuberculous focus exists only after it has broken into the renal pelvis. A careful history and physical examination should be helpful, especially the periodic health examination. Howard long ago stressed the importance of a thorough urine analysis in such cases. It might be helpful to have stained and injected into guinea pigs the urine from individuals who, between the ages of 20 and 40 show white blood cells and a trace of albumin in the routine urine examination. Certainly as Munger suggests, an individual in early adult life complaining of polyuria with some dysuria and a little pus or albumin in the urine deserves to be considered a suspect for renal tuberculosis.

I do not wish to suggest that one should become more diligent in the search for renal tuberculosis for the purpose of performing more surgery. Quite the contrary is true because it would be reasonable to assume that by early diagnosis and proper medical care many kidneys might be saved from probable destruction by progression of the tuberculous disease. Even if this were not possible, certainly by early surgical treatment the prognosis would be much better and the patient saved from the distressing bladder symptoms we so frequently see.

CLINICAL TUBERCULOSIS DATA FOR DIAGNOSIS

The picture of clinical renal tuberculosis may be quite varied. However in a large percentage

TABLE III—STATISTICS OF CASES WITH POSTOPERATIVE DATA

| Age years | Number | Dead | Per cent |
|-----------|--------|------|----------|
| 11 to 20 | 9 | 3 | 22.2 |
| 21 to 30 | 26 | 4 | 15.4 |
| 31 to 40 | 26 | 3 | 7.7 |
| 41 to 50 | 9 | 1 | 11.1 |
| 51 to 60 | 3 | 0 | |

of cases it is so nearly the same that the general practitioner should at least anticipate the disease. In the unusual cases it may be quite difficult or even impossible to suspect the underlying cause.

A carefully obtained history in any surgical condition cannot be too frequently stressed. This is particularly true in tuberculosis. Kretschmer has shown that 20 per cent of his 221 cases gave a history of some previous operation for extra renal tuberculosis. The family history may also be helpful. The development of tuberculosis of the epididymis, either prior or subsequent to the infection of the kidney on the same side, is a frequent occurrence.

Age. More than half of the patients suffering from chronic renal tuberculosis in any series of cases are between the ages of 20 and 40 years, hence it is considered a disease of early adult life. In our series of cases 38 per cent occurred between 21 and 30 years of age and 32 per cent between 31 and 40 years. Thus, 70 per cent of these operative tuberculous kidneys were in patients between the ages of 20 and 40 years. This percentage coincides with the findings of most observers (Table I).

Sex. In our series there were 50 males and 47 females. Similar data from other authors show that tuberculosis of the kidney shows no marked affinity for either sex, and it is our opinion that it affects male and female about equally. The right kidney was operated upon in 51 patients and the left in 46 (Table II).

Symptoms. Patients with renal tuberculosis seek assistance at a comparatively late stage of the disease. This is true because of the usual insidiousness of the onset and the fact that the primary symptoms are not alarming. Then too symptoms referable to the bladder are prone to periods of regression and the palliative treatment, which usually has been instituted receives the credit.

In our most recent series of 34 patients symptoms had been present from 2 months to 7 years, with an average of 20.7 months before the patients presented themselves for examination. Of these 34 all but 5 complained of some bladder symptoms. Pain referable to the kidney was also a very frequent complaint, occurring in 26. This pain was usually dull or aching in character, and



Fig. 2 Pyelogram of left kidney of same patient as in Figure 1

sometimes only a feeling of heaviness. It seems worthy of note that pain should have occurred in as many as 76.5 per cent of these patients. In many it was the primary symptom, and in a few the only complaint (Table III).

Intravenous urography. Since the introduction of uroselectan another distinct aid in diagnosis has been added. This is particularly true in those cases in which it is impossible to catheterize one or both ureters. It is not only helpful in outlining the kidney pelvis but also gives us considerable information regarding the function of both kidneys. Unfortunately however, the kidney pelvis outline is usually not so clear cut and distinct as the outline we obtain by retrograde urography, and it fails entirely to outline the minor deformities in early cases. Intravenous urography has been of diagnostic aid in 12 of the 22 patients in whom it has been used.

Cystoscopic findings. If intravenous urography and the general examination, which includes repeated urine analyses have not yielded sufficient information concerning both kidneys (which is usual), the patient is subjected to a complete cystoscopic examination. This includes a thorough examination of the bladder catheterization of both ureters (when possible), with urine specimens

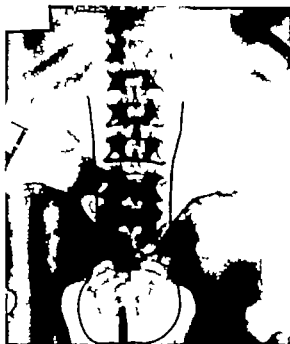


Fig. 3. Plain X-ray picture showing multiple small calcifications in both kidneys caused by tuberculosis. These calcifications are significant of nature's attempt to heal the disease.

collected from the bladder and from each kidney for culture, urea, and microscopic examination, guinea-pig inoculations and potato culture. One cubic centimeter of phenolsulphophthalein is then injected intravenously; a note is made of the time of appearance from each kidney and a determination of the total amount secreted in 10 minutes after the first appearance. Thus, the urea and the phenolsulphophthalein determine the function, and the guinea pig and potato culture prove the presence of tubercle bacilli. A plain X-ray picture is taken of the bladder, ureters, and kidneys with the X-ray ureteral catheters in position, followed by a pyelogram of each kidney and a pyelo-ureterogram with the patient in the sitting posture.

DIAGNOSIS

There is considerable difference of opinion as to how much data is required to make a diagnosis and outline the treatment in a given case of renal tuberculosis. Beer states that the cystoscopic picture, together with the finding of tubercle bacilli in the urine, is sometimes sufficient for diagnosis. He also believes that one should obtain positive smears for tubercle bacilli in 80 per cent of cases that functional tests are significant only late in the disease and that pyelography is rarely

necessary and often harmful. He grants the occasional necessity for exploratory operation. Brunsch and La Pena (4) state that diagnosis of renal tuberculosis is more difficult than it was 25 years ago because in most cases there is less pathology present. They base their diagnosis on evidence of renal destruction as noted by deformity in the pyelogram, but state that the phenolsulphophthalein functional test, positive guinea-pig and uroselectan are all helpful at times. Wade calls attention to diminished bladder capacity in 97 per cent of cases. Pyelograms are more important than functional tests according to Kretschmer who also believes one should not be in haste to operate but should repeat the various tests and pyelograms to prove that the other kidney is free from disease. He states that such delay has never led to a bad result or to any regret. Jeck in reporting 58 cases from Bellevue Hospital obtained pyelograms in only 14, 10 of which were typical enough to warrant operation, and expressed fear of pyelography in these cases. Thomas (16) found the pyelogram to be the first positive localizing finding in 56 of 170 pyelograms studied. He always makes bilateral pyelograms and finds a filling defect usually at the tip of a calyx, often so small as to be easily overlooked. Pyelograms were helpful in making a diagnosis in only 26 per cent of Stevens' cases while Rohrer states that they are unnecessary. Caulk made a diagnosis of tuberculosis in 78 per cent of his cases unaided by pyelograms, but also proceeds with urography though he states it is not helpful in many cases.

The diagnosis of renal tuberculosis is sometimes exceedingly difficult, and we therefore feel that every possible positive or negative evidence is of the utmost importance. Our aim is not merely to determine that tuberculosis of the urinary tract exists but to ascertain exactly where the infection is and to what extent destruction has occurred. Furthermore we are anxious to obtain this information as early as possible so that definite treatment may be instituted to relieve the symptoms, as well as to prevent extension and further destruction. It is true that in certain lesions which progress slowly there may be no hurry to operate, but how are we to determine in any specific case how rapidly the process may extend? It is with this in mind that we subject patients to a thorough routine examination and complete cystoscopy.

There is always the danger of carrying tubercle bacilli to the uninfected kidney by passing a ureteral catheter through the infected bladder. Also a vesicorenal reflux may occur which would permit one to obtain infected urine from a healthy kidney. Beer believes that these incidents are



Fig. 4. Bilateral pyelogram of Figure 3 showing diffuse tuberculosis of both kidneys. The kidney destruction for such an infection is not great. This patient is at present inoperable and is being treated medically.



Fig. 5. Bilateral pyelogram of same patient (Fig. 4) taken 6 months after medical treatment. Note that the filling defects are somewhat smaller possibly due to healing within the kidney. He is free from symptoms most of the time, with occasional remissions of bladder symptoms. His general condition has improved and he is able to continue his employment as a policeman.

common and are occasionally the cause of an erroneous diagnosis of bilateral renal tuberculosis. Thomas (26) has passed catheters to the kidneys of patients with tuberculosis, filled the bladder with methylene blue, lowered the head of the table, asked the patient to strain and looked for the blue dye to come from the catheters. He obtained the dye in 15 per cent of cases. No doubt bacteria may be carried up the ureter with a catheter or a reflux may occur which permits one to obtain bacteria from a healthy kidney. Still, we feel that the information obtained from cystoscopy and careful catheterization of the ureters far outweighs the possible harm to the patient. Reflux up a normal ureter must be rare.

We have come to rely primarily for diagnosis upon the irregularity or filling defect in the pyelogram. Usually other data are necessary for a correct diagnosis although in the most recent 34 cases the pyelograms were considered diagnostic in 28 or 82.3 per cent, with an error in diagnosis in 2 cases. By means of pyelography one obtains more evidence of renal destruction than by other diagnostic means. It is true that occasionally a large pyonephrotic sac or a renal neoplasm may simulate tuberculosis, but in these cases removal of the kidney is the only way to ascertain the pathological process present.

There are two common types of advanced renal tuberculosis which may ordinarily be diagnosed by the pyelogram. The first appears as a large dilated irregular kidney pelvis and a mega-ureter. This type usually has very poor renal function and is the end result of a continuously destructive process. The second type is characterized by shaginess and irregularity of the major and minor calyces without much increase in the size of the kidney pelvis, often with calcifications in the kidney substance, and a small, irregular, beaded ureter. This latter group includes those cases which show a tendency toward healing and usually has a better resistance to the tuberculous infection.

Kidney function tests proved helpful in 26 or 76.5 per cent of our most recent 34 cases. Diminished renal function as determined by urea, phenolsulphonaphthalein, indigo-carmin, or uroselectan gives us an idea of the approximate destruction in the kidney. In early cases in which very slight damage has occurred these tests are often valueless but by the time the urologist is permitted to examine these patients some kidney tissue has usually been destroyed.

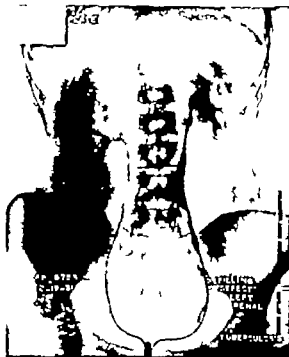


Fig. 6. The filling defect in the left upper calyx is due to tuberculosis. A left heminephrectomy was done, followed by a urinary fistula. One year later a complete left nephrectomy was necessary. This portion of the kidney also showed tuberculosis. At present patient is free from symptoms and has gained weight. (The filling defect in the right pyelogram is due to incomplete injection.)



Fig. 7 Shows advanced destruction caused by tuberculosis.

We rely more upon the percentage of phenolsulphonephthalein excreted in a given time from each kidney than upon the other kidney function tests.

The bladder picture on cystoscopy frequently is sufficiently characteristic to convince one of the presence of tuberculosis. This is very helpful and was present in 25 or 73.5 per cent, of our cases.

Cathelm states that it is impossible to catheterize both ureters in 50 per cent of cases. This may be true at the first examination. In this series, both ureters were eventually catheterized in 28, or 83.3 per cent, although in some cases more than one cystoscopy was required. Occasionally the catheters could be passed only part way up the ureter.

Finding tubercle bacilli in the urine is very helpful in making a diagnosis, and we search diligently for them by stained smears, guinea pig inoculations, and Corper's potato culture. They were discovered in 16 or 47 per cent, of the patients. However we do not hesitate to diagnose renal tuberculosis in the absence of tubercle bacilli in the urine.

TREATMENT

Renal tuberculosis should be considered a localized infection in an individual who has a general systemic tuberculosis, for it would be unreasonable to assume that a kidney could become infected with tuberculosis without the presence of some other focus of the disease in the body. This fact is particularly important in outlining the treatment of this disease. Although our attention is focused on the renal infection, we should remember that the disease is present in some other tissues even though it may be quiescent at the moment. Hence, it would be reasonable to assume that the patient should be treated in the same manner as one suffering from tuberculosis which had manifested itself elsewhere.

So called preclinical tuberculosis should be treated medically. If no renal destruction has taken place, which can usually be determined by the pyelogram, the patient should have the benefit of careful medical care in the hope that the kidney will heal. If a destructive lesion supervenes during medical treatment, surgical measures should at once be instituted.

Destructive unilateral renal tuberculosis is always surgical, and the offending organ should be removed as soon as the diagnosis is made, unless the patient's general condition contra-indicates surgery. Occasionally even in the presence of an open pulmonary tuberculosis, or other systemic disease, it may still be advisable to remove the kidney. As Hunt has pointed out, "In the absence



Fig. 8. Early tuberculosis of the right upper calyx. Nephrectomy resulted in complete cure. Note distortion due to granulations, nature's attempt to heal.



Fig. 9. Early tuberculosis of the right upper calyx. Because of the destruction, a nephrectomy is more urgent in this case than in Figure 8.

of general indications, if the tuberculous kidney is the most significant lesion, its removal is justifiable." Since it is possible to remove a kidney under regional or spinal anesthesia, the operation assumes much smaller proportions, both as to mortality and morbidity. In rare instances it may be advisable to treat this type of patient medically before operation in the hope that his eventual postoperative convalescence may be shortened. It is our custom to begin medical treatment as soon as the diagnosis is established and continue this treatment during the operative convalescence, as well as after operation.

There is considerable difference of opinion concerning the treatment of bilateral renal tuberculosis. Braasch (3) states according to Bumpus that when nephrectomy has been performed, and, following this, urine from the supposedly normal kidney is found to contain tubercle bacilli, the subsequent mortality and the subsequent improvement are practically the same as in those with, as far as can be determined, strictly unilateral involvement. Thomas (26) believes that the removal of one kidney in a bilateral tuberculous infection is not good surgery. Spitzer admits that some circumstances warrant removal of one kidney even when the other is known to be affected, but that these occasions are rare. Caulk,

Beer, Kretschmer, and others are of the opinion that patients with questionable bilateral renal tuberculosis should not be operated upon until it is satisfactorily established that one kidney is uninfected. They also believe that a diligent search should repeatedly be made for tubercle bacilli from the urine of the normal kidney, and if none are found the case becomes surgical. Folsom strongly advocates the immediate removal of a proved tuberculous kidney, provided a clear urine and a normal function, determined by the excretion of indigocarmine or phenolsulphonephthalein, are obtained from the remaining kidney. McCarthy (quoted by Folsom) believes "it is a much less error to remove any number of tuberculous kidneys in what subsequently proves to be a bilateral renal tuberculosis, than it is to inoculate even one healthy kidney with this disease by overzealous instrumentation. Uffreduzzi, according to Forni, has found that animals with bilateral renal tuberculosis, which had a unilateral nephrectomy, lived longer than control animals and that in some cases the progression of the disease in the remaining organ was very gradual. He states that in several instances there was a regression which resulted in a clinical cure healed lesions being found at autopsy. He explains this as resulting from an increased blood supply to



Fig. 10. A diagnosis of right renal tuberculous was made and nephrectomy performed. Pathological report showed an infected hydromatous but no tuberculous. This patient's sister showed a similar condition, which was tuberculous, and helped lead us into this diagnosis.



Fig. 11. Due to this filling defect, three diagnoses were made: (a) Tuberculosis, (b) non shadow-casting stone, and (c) neoplasm. Only symptom was painless hematuria. Nephrectomy revealed a neoplasm surrounding the ureteropelvic junction and extending a short way down the ureter.

the remaining kidney which had a beneficial influence on the tuberculous disease.

Bilateral renal tuberculosis usually manifests one badly destroyed kidney, while the other kidney is only slightly infected. To determine whether or not the second kidney is infected many surgeons search diligently for tubercle bacilli. In recent years a much larger percentage of bilateral infections has been discovered. After making a diagnosis of bilateral renal tuberculosis, most surgeons relegate the patient to a miserable existence and, as statistics show, to almost certain death in a short time. There have been patients (Fig. 1) suffering from bilateral renal tuberculosis, who have had one kidney removed, and at present the disease is at least arrested and there has been clinical improvement. Similar cases have been reported by Braasch (4) Munger and others. If even an occasional patient is benefited and his life prolonged and made more endurable, is not removal of a kidney, the infection of which prevents any possibility of convalescence, justifiable? Medical treatment with surgery is very helpful, because, as often pointed out, if relative immunity cannot be built prognosis is unfavorable.

I do not wish to convey the idea that all patients with bilateral renal tuberculosis should be subjected to operation. There are some patients presenting frankly destructive lesions in both kidneys, and it would be exceedingly difficult to decide which one to remove (Fig. 4). However I believe that if a destructive lesion is definitely proved in one kidney and the functional test of the other is satisfactory even though tubercle bacilli have been found in the urine from it the patient should have the destroyed kidney removed at once. It is our custom to remove the destroyed kidney even when there is pyelographic evidence of a very small infection in the opposite kidney. Inasmuch as the poor outcome in cases in which surgical treatment has been denied has been amply proved and whereas certain patients are definitely benefited by surgical intervention we would prefer to make an error of commission rather than one of omission. We have also come to believe that no patient should ever be told that his condition is inoperable. Under proper care the conditions often change, and in two instances patients who were at first pronounced inoperable were later deemed operable then because of the earlier in-

TABLE IV—ANÆSTHETIC USED

| Type of anaesthesia | Number | Average days in hospital after operation | Immediate results | | | Died |
|--|--------|--|-------------------|----------|------------|------|
| | | | At rest | Improved | Unimproved | |
| Paravertebral | 5 | 18 0 | 50 | 3 | | 1 |
| Paravertebral and inhalation narcotics | 3 | 23 | 14 | 8 | 1 | |
| Inhalation narcosis | 23 | 70 | 70 | | 3 | 1 |
| Avertin | | 15 5 | 0 | 2 | 0 | |
| Spinal | 14 | 8 4 | 6 | 7 | | 1 |
| All types | 47 | 3 6 | 60 | 11 | 4 | 3 |

formation, they both refused operation. They have since died. In these cases there was an apparent regression of the disease in one kidney, while the other became so badly infected that the general health of the patients was impaired. It is difficult to guess what the outcome might have been had they submitted to the operation, but, realizing the hopeless outlook otherwise, heroic measures seem justifiable.

With all the present methods of diagnosis we feel that an exploratory diagnostic operation should rarely be necessary. The condition of the kidney almost invariably can be better ascertained by pyelogram and intravenous urography, than can be done at operation when the surgeon has the kidney exposed. We have occasionally examined a kidney at the operating table which appeared normal and had it not been for the pyelographic evidence the kidney could not justifiably have been removed. We also believe that kidneys occluded with tuberculosis are a probable source of infection dissemination, and should be removed regardless of the absence of symptoms. In general, then when the pyelogram shows a destructive lesion of the kidney which is characteristic of tuberculosis, and particularly when the functional ability is diminished, and when the function of the opposite kidney is normal and the pyelogram is normal or only slightly impaired, we remove the worse kidney, followed by careful medical treatment.

ANÆSTHESIA

Some form of regional or spinal anaesthesia is the anaesthetic of choice, especially in renal tuberculosis. This is true because any inhalation anaesthesia may light up other tuberculous foci. A general anaesthetic will also impose an additional burden on remaining kidney. In our cases, average length of hospital days was less with regional than with inhalation anaesthesia (Table IV).

TABLE V—ORIGINAL SYMPTOMS IN THIRTY FOUR CASES

| | Number | Per cent |
|------------------|--------|----------|
| Bladder symptoms | 29 | 85 3 |
| Pain in kidney | 26 | 76 5 |
| Cloudy urine | 17 | 50 |
| Hematuria | 15 | 44 |
| General symptoms | 13 | 35 3 |

TABLE VI—FINDINGS IN THIRTY FOUR CASES

| | Number | Per cent |
|---|--------|----------|
| Bladder appearance suggestive | 25 | 73 5 |
| Tubercle bacilli proved by guinea pig stain or potato culture | 16 | 47 |
| Able to catheterise both ureters | 28 | 82 3 |
| Functional test helpful | 26 | 76 5 |
| Pyelogram suggestive | 28 | 82 3 |

SURGICAL PROCEDURE

In most cases the kidney with as much of the ureter as possible is removed through the usual kidney wound. Beer suggests the possibility of producing a tuberculous bacillæmia by roughly handling the kidney prior to removal. Nephroureterectomy has been performed once in our clinic, but we believe that the necessity for this procedure is rare. A heminephrectomy for tuberculosis of the upper pole of the kidney was also performed once. This patient required a nephrectomy 1 year later because of a urinary sinus at which time the remainder of the kidney also showed the presence of tuberculosis.

POSTOPERATIVE DATA

We have been able to trace 9 deaths. There were 3 postoperative deaths as shown in Table VII, or slightly more than 3 per cent. The remainder have died from several months to years after operation. From Table III, it will be noted that the largest percentage of deaths occurred in the younger group of patients. Perhaps the infection is more acute in younger individuals or their resistance may be less than in older patients.

MEDICAL POSTOPERATIVE TREATMENT

One who treats tuberculosis must have a sympathetic understanding of this class of patient. He must be a solid support for them to lean on at all times, and one into whose sympathetic ears they may unburden their troubles. Dr Wang of our clinic understands this psychology and always befriends his patients consequently he obtains complete co-operation and some excellent results. He suggests that the patient be informed of the exact nature of his disease in order to obtain his co-operation. The treatment is outlined at once, so that the patients realize the necessity for prolonged care. Their diet is placed on an almost

TABLE VII.—MORTALITY

| Name, age | Operation | Mortality | | Time after operation | Complications | Diagnosis | | Anesthesia |
|--------------|-----------------------------------|----------------------|---------|----------------------------|---|----------------|----------------|--------------------------|
| | | Date of operation | Dead | | | Osseous [?] | Pathol. [?] | |
| C 29 | Left nephrectomy | 2-23 | 2-24-24 | 3 mos. | Tuberculosis of bladder | + | + | Paravertebral |
| R. B. 13 | Left nephrectomy | 2-25 | 3-29-25 | 7 days | Uremia, ureteral stricture | + | + | Paravertebral |
| H. K. 26 | Right nephrectomy | 2-22 | 2-24 | 7/13 | None | + | + | Nitrous oxide gas, ether |
| R. M. | Right nephrectomy ureterectomy | 3-25 | 25 | 9 mos. | Rectal abscess, tuberculosis of rectum | ? | + | Nitrous oxide gas, ether |
| E. R. 29 | Left nephrectomy ureterectomy | 3-8-25 | 3-20 | 7/13 | Tuberculosis of ureter | ? | + | Nitrous oxide gas, ether |
| L. P. 11 | Left nephrectomy ureterectomy | 3-4-26 | 9-26 | 15 yrs. | Pulmonary and ureteral tuberculosis | ? | + | Nitrous oxide gas, ether |
| S. M. | Left nephrectomy ureterectomy | 5-5 | 6-5-25 | 25 days | Tuberculosis, ureter | + | + | Ether |
| B. | Left nephrectomy | 8-7-25 | 8-11-25 | 4 days | Pulmonary embolism | + | ? | Spinal |
| J. C. 6 | Left nephrectomy (not done) | 6-8-26 | 6-27 | mos. | Tuberculosis of bones, lungs, genitalia | + | + | Paravertebral |

individual basis for certain foods aggravate some and are beneficial to others. Wang (30) believes that most patients with genito-urinary tuberculosis should not be put in a sanatorium unless active pulmonary lesions are also present. Most public sanatoria are for patients with tuberculosis of the lungs, with no separate provisions for those with urological tuberculosis and usually no one is particularly interested in the urological patient.

Rest, fresh air, quartz light, tuberculin, and medicinal therapy are employed and the benefits derived are from the combination of these elements. The urological treatment consists in local urethral bladder, ureteral, and renal treatments as indicated. Barnett, in discussing tuberculin therapy states "Never allow a skin or systemic reaction to occur without decreasing the dose. In other words, always be near a reaction or sometimes in one but never on top of one. Warm gominal (20) 2 per cent is instilled into the bladder twice a week for vesical irritations, and, combined with methylene blue by mouth, seems to be helpful to some patients.

In our most recent 34 cases a lumbar sinus was present on leaving the hospital in 23 or 67.7 per cent. Many of these healed promptly with medical care. Wang (30) stated that all were closed in 8 months and an average of 4.2 months were required to heal these sinuses. In studying the cause of sinus formation no conclusions could be reached since sinuses were present following nephro-ureterectomy in old long standing disease of the kidney and in early renal tuberculosis.

Pain in the remaining kidney was a distressing symptom for several months in many patients. This probably is due to the compensatory hypertrophy and increased blood supply to this kidney with resultant tension of the renal capsule.

SUMMARY

The following summary is based on a review of the literature and a study of 97 patients who have had nephrectomy for tuberculosis.

1. Preclinical tuberculosis of the kidney is the stage between the time when the tubercle bacilli enter the kidney and the time when clinical evidence of extension to the bladder gives rise to symptoms. A few pus cells in the urine of an individual between 20 and 40 years (excluding venereal disease) should make one suspicious of renal tuberculosis.

2. The original symptoms complained of in 34 cases were: bladder symptoms, 85.3 per cent; pain in the kidney, 76 per cent; cloudy urine, 50 per cent; hematuria, 44 per cent; general symptoms, 35 per cent.

3. Diagnosis is established primarily by the pyelographic findings, with evidence of decrease in the renal function in advanced cases. We were able to catheterize both ureters in about 82 per cent of cases. The appearance of the bladder was suggestive of tuberculosis in 73 per cent of the patients studied. The finding of tubercle bacilli is not necessary for correct diagnosis in most cases.

4. Seventy per cent of the patients were between the ages of 20 and 40.

5 Intravenous urography is a distinct aid in some cases but cannot replace pyelography.

6 Bilateral pyelograms should be obtained routinely if the ureters can be catheterized.

7 Nephrectomy, followed by proper medical treatment, offers the only hope of arresting unilateral destructive renal tuberculosis. As much of the ureter should be removed as is possible through the kidney wound.

8 Nephrectomy should be performed in those patients manifesting a destructive lesion in one kidney with good function of the remaining kidney where the second kidney can be shown pyelographically to be only slightly if at all affected. This is heroic, but offers the only chance of prolonging life with a possibility of arresting the disease in the remaining kidney. Repeated cystoscopic examinations in an attempt to find tubercle bacilli from a pyelographically normal kidney when the other kidney has a destructive tuberculous lesion, should be condemned.

9 Exploratory operations are, today, rarely if ever justifiable more evidence should be obtained in most cases before surgery is undertaken than can be gained at the operating table.

10. Some form of regional or spinal anaesthesia should be used in preference to a general anaesthetic.

11 The mortality is higher in younger patients who develop renal tuberculosis.

12 The operative mortality was approximately 3 per cent.

13 A lumbar sinus was present in 23, or 67 per cent, of our most recent 34 cases when they left the hospital, all of which healed in an average of 4 months.

14 Pain in the remaining kidney following nephrectomy is common.

15 Medical care is an essential part of the treatment of renal tuberculosis and should be carried out by one thoroughly familiar with this work.

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TORSION OF THE SPERMATIC CORD¹

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THIRTEEN years ago² I reported two instances of torsion of the spermatic cord. One was seen with Dr. William C. Quimby and the other was a patient of the late Dr. C. E. Porter. There was very little concerning this subject in the available textbooks and I found, after a complete review of the literature, that only 124 instances were on record. After this study it seemed to me that torsion of the cord must be a much more common occurrence than the records indicated. Since that time I have carefully questioned and examined each patient I have seen in whom there was complete or partial atrophy of the testicle. My conclusion is that torsion of the cord is not the clinical rarity formerly supposed and that atrophy of the testis following so called orchitis is in fact the end result of torsion in a considerable percentage of instances.

The fact that there have been twice as many instances of torsion reported in the past 10 years compared with the entire literature preceding this time suggests a more common recognition of the condition rather than a more frequent occurrence.

In addition to reporting 6 additional personal observations together with 3 patients from the service of my colleague, Dr. Corbus, there are several reasons why this subject should be brought up again. Most patients with acute torsion of the cord are seen first by their regular physicians who as a rule do not consider this condition in making a differential diagnosis. The diagnosis of orchitis, epididymitis, or acute hydrocele is frequently made without proper correlation of history, symptoms, and physical findings. Since operative interference results in conservation of the testis only when resorted to in the first few hours after the onset of symptoms, it is necessary that the diagnosis be made at the earliest possible moment.

Torsion may occur at any age. It has been recognized shortly after birth and in one of my patients occurred at the age of 68 years. It probably occurs more frequently during childhood and adolescence as indicated by the reported cases, although it is possibly more often correctly diagnosed during this period of life because the physician has less reason to err in the diagnosis of gonorrheal epididymitis in these younger patients.

Torsion has been observed somewhat more commonly on the right side and in slightly more

than half of the cases in incompletely descended testes. Here again it is possible that this recognition has not been because torsion occurs more commonly in undescended testes but because surgical interference has been more frequently advocated than in normally descended testes. The diagnosis of torsion was made during operation the cause of the swelling was often not suspected before operation.

The most plausible explanation is that torsion is always brought about by contraction of the cremasteric fibers. There must be an abnormal attachment of the testis and a certain deficiency in make-up of the gubernaculum associated with a more or less capacious tunica vaginalis. This anatomical variation would not cause torsion the twist itself resulting from repeated contraction of cremasteric muscle bundles, strands of which may be anomalous. Therefore, the degree of torsion, that is the number of half turns or full turns the cord undergoes, depends indirectly upon the freedom of the testicle to be rotated inside the tunica and directly upon the strength of the muscular contraction.

Torsion is said to come on most frequently during sleep but I have seen only one such instance in 11 cases. Strain of any sort, running, coughing, crossing the legs, etc. are mentioned as exciting factors. Gradual and repeated strain is more often noted in the recurrent cases as coitus, and straining at stool.

At operation the pathological findings are characteristic. The cord above the torsion contains either dilated or flattened and partially obliterated spermatic veins, depending upon the extent of their occlusion in the twist. The spermatic artery is always greatly dilated but usually pervious. If the condition is an acute one the surrounding tissue is edematous; if chronic it is adherent and fibrous. In the acute cases the twist occurred from without inward in over two-thirds of the patients. In the recurrent cases no definite rule can be formulated. The extent of the twist varies from one half turn to two full turns and the site of the twist is always in that free portion of the cord which, covered by tunica vaginalis, suspends the epididymis and testicle.

Incision into the tunica vaginalis reveals, in the early stages, more or less blood stained fluid while in the longer standing process old blood clot entirely fills the tunica. The remainder of the

cord below the twist, including the epididymis is greatly swollen and bluish or purplish in color, while the spiral intersections produced by the twist are clearly seen. The testis itself may be only slightly enlarged or it may be treble the normal size.

On section the parts show intense engorgement, red blue, or black depending on the duration. In the longer standing cases there is a destruction of the testis not a necrosis in the ordinary sense of the word but an aseptic death of the gland which in process of time undergoes fibrification and consequent atrophy if left in the scrotum. In the recurrent cases any sharper attack than usual may cause lymph to be deposited in the tunica vaginalis and form adhesions anchoring the testicle. Microscopically there may be seen hæmorrhagic infarction no organ left but merely old blood clot or a diffuse interlobular hæmorrhage.

SYMPTOMS

The onset occurs with a varying degree of pain in the lower groin of the affected side. In the cases herewith reported 7 of the 9 felt pain more or less immediately after physical strain. In the acute cases which do not subside the pain becomes progressively more severe and localizes in the testis and lower cord. A characteristic diagnostic point is that swelling of the scrotal contents begins immediately and this swelling gradually increases for from 12 to 24 hours when it ceases. It is at this time that the severity of the pain is greatest. Careful observation will show that the swelling involves the cord only to the degree of the height of the twist and the scrotum becomes diffusely reddened and tense. In the case of a testis lying high up in the inguinal canal the superficial structures of the groin assume this appearance. Another diagnostic feature, if seen in the first few hours, is that the swelling has the appearance of being drawn upward in the scrotum or inguinal canal due to the shortening produced by the torsion.

When seen early the epididymis is normal in outline but is not in its usual relation to the body of the testis being anterior or lateral rather than posterior. Toward the height of the swelling the outline of the testis and epididymis becomes obscured due to hæmorrhage into the tunica and generalized oedema of these tissues. There is very slight systemic reaction in the majority of cases and the temperature pulse and leucocyte count do not seem compatible with the severity of the local condition. Nausea, vomiting urinary frequency weakness, and malaise may occur but are not part of the usual clinical picture.

If no attempt is made to untwist the torsion there is usually a gradual subsidence of all pain after 2 to 5 days, but the swelling and local tenderness persist for from 10 to 14 days. In 2 of my patients the pain was so severe 48 hours after the onset that generous doses of morphine failed to relieve it. The usual sequel is a gradual atrophy of the testicle due to fibrotic changes. The epididymis is much less affected in this atrophic process and in 4 of these cases has remained practically normal to palpation. Gangrene of the testicle has occasionally been reported but I have never seen torsion associated with active infection of the scrotal content.

DIAGNOSIS

In infants and younger boys orchitis, epididymitis, strangulated hernia and acute inguinal adenitis must be differentiated from torsion. The average practitioner of medicine seems content with the diagnosis of orchitis for most acute or chronic swellings of the scrotal content. Strictly speaking orchitis as seen clinically is a relatively rare condition except for the orchitis accompanying mumps and the hæmorrhagic reaction resulting from direct trauma. Secondary orchitis due to extension of infection from the epididymis is usually so slight as hardly to justify the term except in rare cases in which the epididymal involvement is so intense as to block the circulation of the testicle by the peri-epididymal infiltration. Orchitis due to syphilis whether it be the interstitial or gummatous type is not an acute disease involves the body of the testis and not the structure of the cord, and is never to be confused with torsion.

If the differential diagnosis will be analyzed on the acute onset, lack of findings coincident with epididymitis either gonorrhœal or non-specific exclusion of strangulated or incarcerated omental hernia, non transilluminable scrotal content and the finding of a reddened tense scrotum with elevation of the testis and limitation of the swelling to the lower inguinal canal it is probable that fewer diagnoses of orchitis will be made and a higher incidence of torsion discovered.

PROGNOSIS

So far as recorded torsion of the spermatic cord has never proved fatal. In recurring torsion the attacks usually continue with a resultant atrophy accompanied by intermittent neuralgic pain unless an orchidopexy is performed. A few patients have had no recurrence after the first manipulation of untwisting the cord. The important feature of this condition is immediate diag-

nous because in the acute cases operative detorsion in the first 3 or 4 hours will often result in the conservation of testicular tissue (Case 2). After 24 hours operation is only indicated to relieve pain or to eliminate the remote possibility of gangrene. In several instances seen after the severity of the pain had begun to diminish palliative treatment has been advised rather than operation the prediction being of course that more or less complete atrophy would result (Case 8).

TREATMENT

1. *Detorsion* has been successful in a few cases of torsion in fully descended testes when seen very shortly after the onset of symptoms. It should, therefore, always be attempted in cases seen early but only in those in which the testis is outside the external abdominal ring. It is obviously impossible if the strangulation has existed long enough for engorgement of the testis to occur or for much fluid to accumulate in the tunica vaginalis.

Detorsion is accomplished by grasping the testicle between the thumb and second finger and slowly rotating on the vertical axis, trying first from within outward as the torsion most often found has occurred in a counter-clockwise direction. No force should be used and torsion should be continued until relief is felt or pain and resistence become so severe that it is obviously the wrong direction.

In one instance reported in the literature a patient with recurrent torsion was taught to perform detorsion successfully upon himself for many years. However if after a successful detorsion has been accomplished, the condition recurs, an orchidopexy is indicated.

My most recent patient with this condition has been able to perform detorsion successfully for 4 months. His symptoms had been present for 3 months and when first seen he had 50 per cent atrophy of the testis. There has been no increase in atrophy and so far he refuses orchidopexy (Case 9).

2. *Orchidopexy* should be performed in all cases in which it is deemed advisable to save the testis and in which there is no anatomical condition present that will interfere with the success of the procedure.

The usual transposition can be done on undescended testes with satisfactory results. In fully descended testes any operation that performs and accomplishes a fixation preventing recurrence will achieve a cure. A simple eversion and suture of the tunica vaginalis is usually sufficient.

3. *Orchidectomy* In an adult where transposition of the undescended testis cannot be satisfactorily accomplished or in any case in which necrosis, gangrene, or persistent circulatory obstruction is present, removal of the testis and the involved portion of the cord is indicated unless the patient has already passed through the period of pain and increased swelling. In this event, best applied locally and a week or 10 days of rest and a suspensory achieve relatively the same result as orchidectomy.

CASE REPORTS

(Cases given in abstract for purpose of brevity)

CASE 1. M. aged 13 years, a patient of Dr. Corbo and seen with him, appeared June 5, 1927 stating that after riding home from school on his bicycle he had been suddenly taken with a severe pain in the region of the right testicle. The pain continued with increasing severity all night and when seen some 30 hours later had already begun to subside. The swelling involved the entire right scrotum which was red and tense and symmetrical. There was no tenderness or swelling above the external inguinal ring and the testis was definitely drawn up suggesting torsion. Although not definite the epididymis seemed to be anterior to the body of the testicle. All other tests being negative, a diagnosis of torsion was made and immediate operation advised. The father preferred to wait and after 3 days of rest and hot applications the pain subsided and the swelling began to decrease. After 3 weeks the testis was replaced by a small soft mass with a normal epididymis felt anteriorly. This patient was seen in February, 1932, and practically no remnant of testis could be felt in the right scrotum and although the epididymis was small it was of usual consistency.

Diagnosis: Torsion of right spermatic cord—atrophy N. operation.

CASE 2. C. S. aged 58 years, referred by Dr. Frederick Tice, was seen 2 hours after onset of severe pain in left testicle which came on after straining at stool. The testis was twice normal size, elevated toward the external ring, epididymis on external side of testis instead of posterior. Temperature and leucocyte count were normal and urine, prostate, and other tests were negative. A diagnosis of torsion of the cord was made and within 3 hours after the onset of symptoms the scrotum was incised and a rotated cord with one-half twist (80 degrees) was found just below the external ring. After detorsion and the application of hot pads for several minutes the circulatory flow seemed improved so the testis was replaced in the scrotum and several sutures served to anchor it in place. Operation was performed on September 3, 1927 and when last seen in December, 1930, the testis was normal to palpation and no further pain has occurred.

Diagnosis: Torsion of left spermatic cord.

Operative detorsion in 3 hours. No subsequent atrophy.

CASE 3. M. J. aged 36 years, came to the Washington Boulevard Hospital on October 9, 1927. He was a railroad brakeman and stated that on the previous day after uncoupling cars and jumping to the ground he was seized with a severe pain in the right testicle and had to be driven home. The pain increased constantly all night and so admission was required one half grain of morphine to quiet him. The testis was drawn up in the right scrotum, was twice normal size, and very tender. The scrotal skin was reddened and slightly edematous. There was no swelling

or tenderness above the right external inguinal ring. Because of a mucoid urethral discharge, which contained pus but no gonococci, the interne made a diagnosis of right epididymitis. Dr. A. R. Metz asked me to see the patient the next day because of an increase in swelling and pain. Temperature and leucocyte count were normal. A diagnosis of torsion of the cord was made and operation performed immediately. The cord just below the external ring was twisted one and one half times (540 degrees) and the testis was completely replaced by blood clot and disintegrated reddish-brown material. The cord was severed 3 inches above the twist and both testis and cord removed *en bloc*.

Diagnosis (Dr. E. R. LeCount) Necrosis of, and hæmorrhagic infarct of right testicle due to torsion of the cord

An interesting feature of this case, not previously seen mentioned by me, was a subsequent claim for damages against the company on the contention of injury compensable in line of duty. Settlement was made out of court.

CASE 4. A. K., aged 31 years, employee of an X ray company, was referred by his employer on April 4, 1927. He stated that on April 1 while adjusting some equipment he had fallen from a ladder about 5 feet from the ground. A severe pain in the right groin caused him to double up and within an hour the right scrotum was swollen and tender. He returned to Chicago from the small town in which he was working and remained in bed, applying heat to the scrotum, for 3 days. When first seen the pain was very severe. Temperature, leucocyte count, and all other tests were normal. The right scrotum was three times normal size, tender and non-transilluminable. The swelling extended up to the external ring and was pear-shaped at this point. A diagnosis of torsion was made and immediate operation performed. The cord was twisted almost one complete turn (345 degrees) and there was an apparent dry gangrene of the tissues within the tunica. The twist was a spiral one extending from the external ring and terminating just above the globus major. The cord and testis were removed.

Diagnosis Torsion of the right spermatic cord. Orchiectomy

This patient returned on October 28, 1928, stating that he had had fleeting pains for several months in the left testicle. Examination revealed no evidence of torsion but a moderate scrotal varicocele. Having read up on this subject the patient was in fear of torsion on the left side and demanded an orchidectomy. This was done and examination in October 1932 shows a normal testis free from pain.

CASE 5. M. H., aged 68 years, Jewish rabbi, was seen with Dr. Doinick on March 8, 1930. Four days previously on stepping out of the bath tub the patient felt a sudden severe pain in the right groin and scrotum and immediately noted a slight swelling. The pain continued to increase and the swelling progressed until the scrotum was four times normal size. A diagnosis of strangulated inguinal hernia was made but on hospital examination the temperature, leucocyte count, and bowel movements were normal and the diagnosis was changed to orchitis. The pain was so severe that morphine would not relieve it and the patient had to be strapped in bed and attended by a burly male nurse to prevent attempts at throwing himself out of the window. On examination (4 days after onset) the swelling extended to the external inguinal ring at which point it was pear-shaped. The skin of the scrotum was blue but not oedematous. No outline of epididymis could be felt. All other tests being negative a diagnosis of torsion was made

and operation performed in a few hours. The cord was twisted one and one quarter times (450 degrees) and a large sclerotic spermatic artery could be seen ineffectually pumping at this point. The testis was replaced by 500 cubic centimeters of bluish black bloody fluid with a few strands of testicular tissue floating about.

Diagnosis Torsion of right spermatic cord. Destruction and hemorrhage into testis. Orchidectomy

CASE 6. (Reported through courtesy of Dr. B. C. Corbux.) Boy, aged 11 years, referred by Dr. L. Hagen on March 6, 1928. Two days previously he had fallen from his bicycle and within an hour experienced pain in both testicles. There had been no direct trauma to the scrotum and there was no bruise or ecchymosis. Both testicles were twice normal size, drawn high up in the scrotum with pear-shaped swelling terminating at the external ring. The vasa on either side were normal and no nodules could be felt. All other tests were negative, temperature and leucocyte count normal. A diagnosis of bilateral torsion of the cord was made and immediate operation advised in the hope of saving some testicular tissue. Another consultant, however, disapproved this procedure and diagnosed the case as one of acute tuberculosis of both epididymides. The swelling and pain persisted for 3 weeks and then began to subside. The boy was taken to California and given several months of outdoor treatment. During this time the swelling completely disappeared and examination in October 1932 by Dr. Hagen shows complete atrophy of both testes with normal epididymides and vasa. The boy now shows evidence of testicular deficiency in his development. There now seems no doubt about the accuracy of the diagnosis of bilateral torsion and it seems too bad that operative interference was denied this boy even if the chance of retaining some testicular activity was slight.

CASE 7. (Reported through courtesy of Dr. B. C. Corbux.) J. R. aged 4 years, was admitted to the Evanston Hospital on December 10, 1929. His parents stated that 36 hours previously he had complained of sudden severe pain in left scrotal region after coming in from the play ground. When put to bed the pain disappeared and did not recur until the middle of the night, when the testis began to swell and the pain returned for several hours. Twelve hours prior to admission the pain recurred with constant severity and the scrotum became reddened and more swollen. On admission the child was in severe pain, the scrotum red and tense, and a swelling extending to the external ring. Temperature 100.4 degrees F. pulse 130 respiration 30, normal urinalysis and leucocyte count. Physical examination was negative in every respect except for the left scrotal swelling and the right testis retained in the inguinal canal. A diagnosis of torsion was made and immediate operation performed. The left spermatic cord was twisted just below the external inguinal ring one and one half times (480 degrees). This was untwisted after freeing the testicle and after 10 minutes of hot applications the circulation seemed re-established. The testis was returned to the scrotum and fixed in place. Recent examination shows an atrophy of about 70 per cent, normal epididymis.

Diagnosis Torsion of left spermatic cord. Operative detorsion orchidectomy. Subsequent partial atrophy of testis.

CASE 8. S. R., aged 24 years, referred by Dr. Brody on January 12, 1933. Five days previously after carrying a armful of heavy law books, he had a sudden knife like pain in the right groin. The pain continued for 48 hours and during this time the right scrotum gradually became larger more tender and reddened. Morphine and hot applications were given for the next 48 hours to aid in quieting the pain. When I saw the patient the swelling was in the upper right scrotum terminating in a knob-like pro-

tubercle just below the external ring. The structures above were normal. Temperature and leucocyte count had been normal. Prostate and urine were normal. The diagnosis of torsion of the right spermatic cord was made and no further treatment except rest advised. An atrophy of the testis was predicted. On February 1932, the patient had normal scrotum, epididymis, and vas, and almost complete atrophy of the right testis.

Diagnosis. Torsion of the right spermatic cord no treatment subsequent atrophy of the testis.

CASE 9. H. R., aged 39 years, referred by Dr. Fisher on April 12, 1932 with the complaint that for 3 months he had had intermittent attacks of pain in the right testis and pain accompanied by transitory swelling and elevation of the right testis. There was no history pertinent to this complaint, no previous venereal disease, and no signs of gonorrhea. The patient had never had mumps. Examination disclosed a moderate swelling of the right scrotum and the testis high up with epididymis anterior to the body of the testis. By grasping the testis between the thumb and middle finger and rotating in a clockwise direction the epididymis was placed posteriorly and the swelling and pain subsided in a few minutes. For economic reasons the patient refused orchidopexy and after instructions as to the manner of performing detorsion himself while sitting in a tub of hot water he has successfully relieved the condition on 6 occasions. When last seen on October 3, 1932 he

had 50 per cent atrophy of the right testis and although again advised to have the testis fixed in place surgically feels satisfied with the present condition.

Diagnosis. Recurrent torsion of the right spermatic cord successful non operative detorsion partial atrophy of testis.

SUMMARY

Torsion of the cord is not the clinical rarity previously implied by isolated case reports. Nine additional cases are cited, 5 of which were verified at operation, 3 by the findings and subsequent course, and 1 an obviously recurrent type with gradually developing atrophy. Orchitis, as a clinical entity except in association with epidemic parotitis is an uncommon condition and the term should not be loosely applied to explain undifferentiated scrotal swellings. Bearing in mind the characteristic sudden onset of torsion with the more or less typical local findings will enable an early diagnosis with immediate operative detorsion which is necessary in most acute cases if testicular tissue is to be conserved.

BILATERAL LOBECTOMY

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LOBECTOMY for intractable suppurative bronchiectasis is gaining favor. Most surgeons and not a few internists, agree in theory at least that removal of the affected lobe is the reasonable and desirable method of attacking this hopeless and distressing disease. The high risk of the operation has prevented its performance in all but the most desperate cases, and has caused many surgeons to cast about for less dangerous substitutes. None of the substitutes however have given as many complete and satisfactory recoveries in the patients surviving operation as has removal of the suppurating portion of the lung. Many patients that have submitted to thoracoplasty, and other indirect methods of attack, as well as many that have been operated upon by cauter pneumotomy, have had to undergo tedious and trying periods of treatment from which the survivors have emerged, some of them crippled some not but not many really cured. It is not surprising therefore, that some surgeons, who frightened by their operative deaths abandoned the operation, have bent their efforts toward lessening its danger and have returned to it again and again, while other pioneers notably among them Lillenthal, have remained unappalled and held steadfastly to a method that seemed to them to be sure of ultimate success.

The dangers of lobectomy are diminishing. In 1915 Lillenthal who has had a wider experience than anyone else reported 34 lobectomies for bronchiectasis and allied suppurations with 21 deaths—a mortality of 62 per cent.¹ In June of this year Ballou Singer and Graham report a collected series of 212 lobectomies by various operators with a mortality of 34 per cent.²

Although the death rate has been halved in the last 7 years intervening between Lillenthal's textbook and the recent collected report, it is still too high to make the operation one to be advised for any but hopeless sufferers. As the authors say 'Even if we take only the more recent and the more favorable figures we still find that a patient with bronchiectasis who submits to a lobectomy runs about a 15 or 20 per cent risk of dying because of the operation and that if he recovers from the operation he has only about a 65 per cent chance of having a thoroughly satisfactory result

with solid healing of the wound.' This is true, yet the halving of the mortality in the last 7 years is promising and the recent successful series of many operators—Alexander Brunn, Sauerbruch Shenstone, and others—give reason to hope that bronchiectasis may yet prove to be a disease curable without too great a risk.

Surgical efforts have hitherto been confined to more or less unilateral bronchiectasis. Bilateral disease has usually been barred from active intervention. Krampf,³ however in a recent communication from Sauerbruch's clinic states that we should consider abandoning our conservative attitude toward bilateral bronchiectasis. He states that one side is often worse than the other and that surgical attack on the worse side should be considered.

This is not the place for an extensive discussion of lobectomy however the following report of a bilateral lobectomy in a patient observed over a period of 8 years may serve to show its possibilities.

On February 8, 1924, Dr. Frank Sheehy was so kind as to ask me to see Miss Dorothy F. with him. She was then 16 years old. She had coughed and expectorated ever since she could remember certainly since the age of 5 years. She had the measles as a child, but it is not certain that her cough dated therefrom. She had pneumonia in 1917 which lasted 3 weeks. She had a severe attack of influenza during the 1918 epidemic her expectoration ceased during this attack. One of her three brothers has a bronchiectasis, two others and a sister are well. Her parents had no lung trouble.

On first examination she was a rather pale child with numerous acne postules and their scars. Her fingers were not clubbed. The lower left side of the chest lagged a little. There was a triangular area of dullness over the left base next the spine, with diminished breath sounds. The sputum was thick, green, foul, and occasionally contained a little blood. It amounted to 180 cubic centimeters per day and 120 cubic centimeters at night. Repeated examinations failed to reveal tubercle bacilli, fungi, or other specific organisms. Cultures gave a growth of almost pure streptococci in short chains. X-ray films demonstrated a triangular shadow lying behind the heart, and for the greater part covered by it.

We thought that this shadow might represent a localized empyema to which bronchiectasis might be secondary.

On February 16, 1924, about 3 inches of the eighth, ninth, and tenth ribs were resected. The pleura was thickened. No pneumothorax resulted until aspiration of the area corresponding to the triangular shadow was attempted. No pus was found. The pleura was opened. There were a few fine elastic adhesions between the base of the lung and the diaphragm. There was no empyema. The



Fig. 1



Fig. 2



Fig. 3



Fig. 4

Fig. 1. February 2, 1928. Bilateral bronchiectasis before lobectomy. Large tubular dilatations of both lower lobes filled with iodized oil. Anteroposterior projection.

Fig. 2. February 21, 1928. Bilateral bronchiectasis before lobectomy. Large tubular dilatations of both lower lobes filled with iodized oil. Right lateral projection.

Fig. 3. February 2, 1928. Bilateral bronchiectasis before

lobectomy. Large tubular dilatations are noted in both lower lobes which are filled with iodized oil. Left lateral projection.

Fig. 4. July 8, 1932. Bilateral bronchiectasis after removal of both lower lobes. Some dilated bronchi still remain in the right middle lobe from which the patient's sputum probably comes.

regular density corresponded to a doughy infiltrate which lay posteriorly in the substance of the left lower lobe.

Its base measured about $3\frac{1}{2}$ inches across and lay on the diaphragm. It ran up about 4 or 5 inches toward the hilum. A needle introduced into it withdrew a little

The infiltrated area was attached to the chest wall by a dense pack, sewed over it, and the chest was rapidly closed.

A collection formed in the chest which splinted the lung and reduced the sputum first to 50 cubic centimeters, then to 10. In view of the cessation of expectoration, the lung was not opened. Some 6 weeks after operation the patient's temperature rose and the effusion became purulent. A large amount of pus was discharged from the incision.

The empyema healed rapidly, but as it healed and the lung expanded, cough and expectoration returned. In August, 1924, 6 months after operation she had bubbling rales over both bases and I thought that the bronchiectasis was bilateral.

A year after the first operation, in February, 1925, she was admitted to the San Francisco Hospital. On February 2, 1925, the old scar was excised, pieces of two ribs were resected, and the adherent lung cauterized. Several cavities were opened. The fistula closed very rapidly; the sputum remained undiminished. It was thought to come from the right side. She was discharged April 11, 1925, with 125 cubic centimeters of sputum and a wound that was still open but drained very little. The wound closed in May, 1925.

X-ray pictures of March 16, 1925, with iodized oil disclosed dilatation of the right basal bronchi. In November, 1925, she had no more fever but expectorated 5 or 6 ounces of sputum daily.

In February, 1928, I saw her again. She had been at Hanging in southern California taking sanatoria. She had lost considerable weight, had intermittent attacks of fever, swelling of the joints, and severe headaches. In September, 1929, she had gained weight, but was otherwise worse. The sputum measured 6 or 7 ounces per day. Bronchoscopy on February 24, 1930, revealed much secretion from the right

bronchi, less from the left. The larger bronchi were anatomically normal. In October, 1930, the ethmoid sinuses were drained by Dr. W. B. Smith. This improved her headaches, but not her expectoration. On March 3, 1930, $3\frac{1}{2}$ inches of the seventh, eighth, and ninth ribs were resected, the wound was packed with gauze, and the chest closed. On March 9, the wound was reopened and a saucer shaped portion of the adherent pleura and lung removed with a Percy cautery. A number of bronchi were opened from which air came, but no pus. This opening, like that in the left side, healed rapidly. The sputum was undiminished, and finally, a year and a half later on September 26, 1931, a right lower lobectomy was decided upon. My notes read:

An incision was made in the old scar and the pleural attachment of the bronchial fistula, and thereafter the right lower lobe exposed. At this juncture the patient stops breathing and becomes very blue; however upon her giving a few breaths, operation is proceeded with and the right lower lobe, which is much shrunken but riddled with bronchiectatic cavities, rapidly freed of its attachments. With some trouble, through the small chest opening, three or four right angled clamps are placed on the hilum and each of them tied with a black silk ligature which is left long and led out through the wound. The lower cavity is packed with gauze soaked with mercurochrome. The bottom of the right middle lobe, which comes to view as the anesthesiologist dilates it, is pink and air-containing.

Following operation the rectal temperature rose to 103 degrees and the pulse to 120; her respiration reached 30 some days later. Temperature and pulse rate receded to normal in the course of a week. At no time did the patient appear alarmingly ill. She stated that her discomfort was far less than after her previous cavity operations. The ligatures came away about 2 weeks after operation. The patient was out of bed on the nineteenth day and was discharged on the twenty-third day. At the time of her discharge she had normal temperature; her sputum averaged 30 to 45 cubic centimeters per day. In the next few months she continued to have intermittent attacks of fever and

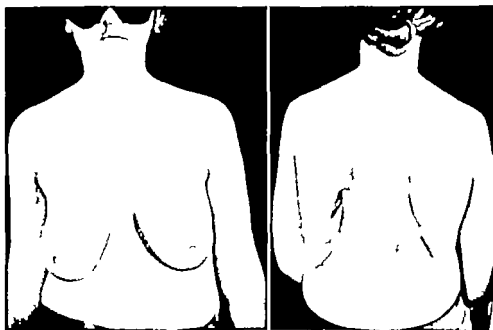


Fig 5. left Patient after bilateral lobectomy

Fig 6. Patient after bilateral lobectomy The left sided opening has entirely closed since this photograph was taken.

the sputum rose to 3 to 4 ounces per day. There was considerable discharge from the bronchial stump but the fistula closed spontaneously about January 1932 and has remained closed since. Sputum and intermittent attacks of fever continuing. It was decided to remove the left lower lobe over which riles could constantly be heard. This was done January 26 1932. My notes read:

In a girl who after right sided lobectomy last August, continued to have sputum which, from the physical signs and from the X-ray examinations, doubtless came from the left lower lobe, removal of this lobe was decided upon in the hope of ridding her of her profuse expectoration. This lobe had been cauterized according to the method of Graham years before.

The old scar was therefore opened under satisfactory local and gas anesthesia. The adhesions between the parietal chest wall and the site of the operative defect were separable without difficulty. Those to the diaphragm and those in the entire lobar fissure were so dense that, in separating them, a hole was burnt with the cautery into the diaphragm, which was recognized and immediately repaired with chromic gut. The hilum having been reached, two large Wertheim clamps were applied to it, tied about with silk ligatures on a needle the clamp reapplied and the lobe removed above the clamp with the cautery. It was cauterized and contained large bronchiectatic cavities from which thick pus exuded. The resulting cavity was packed with a Mikulicz tampon and plain gauze.

Again she made a good recovery. Her temperature rose to 102 degrees after operation and the pulse to 110. By the tenth day the temperature was fluctuating between normal and 100, and the pulse between 70 and 90. The respiration at no time exceeded 28 per minute. She got out of bed on the twenty-second day after operation and was discharged from the hospital on the twenty-fourth.

On July 7 1932 she stated that for about a month after the last operation cough and expectoration had practically ceased. She then caught a "cold" and had much pain in the head, especially on the right side. She had a cough from the nose. Following this cough and sputum increased so that it now reaches 120 cubic centimeters per day.

On examination the bases of both lungs were considerably through the defects in the chest wall. The chest had remained closed. On the left there was a spot of granulation tissue through which about a centimeter of pus came when she coughed. There was a strip of bronchial breathing at the base of the right lung. A pressure bandage was applied to the bulging area on the left and in place by a few turns of plaster of Paris diminished the cough and expectoration which was to 60 cubic centimeters daily. A celluloid pad has been made to take the place of the plaster. The vital capacity on August 15 1932, 700 cubic centimeters. The patient attends school and is not dyspnoeic on ordinary exertion.

REMOVAL OF VERTEBRAL BODIES IN THE TREATMENT OF SCOLIOSIS¹

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THE impossibility of correcting by ordinary methods lateral curvatures caused by hemivertebra led to the attempt in July 1924, to remove the anomalous wedge-shaped body and its arch. Because growth of the vertebral column is not checked by the spine fusion operation it is believed that this procedure alone could have no effect upon the progress of such a curve and that the latter would continue to increase so long as the hemivertebra continued to grow. It also is self-evident that jackets or other apparatus could have no influence whatever upon such a deformity. The application of the operation of partial vertebral removal to the treatment of certain advanced cases of scoliosis not due to hemivertebra in which marked structural deformity prevented correction by ordinary means, next suggested itself. From July 1924 to June 1928, 10 patients, 5 with curvatures caused by hemivertebra and 5 with ordinary scoliosis, were operated on for removal of vertebral bodies.

The ages of the patients at the time of operation varied from 1½ to 22 years with an average of 11½ years. The hemivertebra group were younger than the scoliosis patients, the former averaging slightly more than 6 and the latter 17 years. Because it was believed at first that the best results could be obtained only in young children before severe deformity had become established the first 3 patients were operated on at a very early age, 3 years and 17 months, respectively. It soon was appreciated that children of this age could not well tolerate an operation of this severity and no further cases were undertaken at less than 6 years.

The plan of operation in the earlier cases was to approach the vertebra through a dorsal midline incision over the spinous processes, or one parallel to and a short distance from the midline. The posterior arches were exposed subperiosteally and the spinal muscles were divided transversely on one side at the level of the vertebra to be removed and retracted laterally. In the dorsal region the posterior portion of three ribs, including the one above and that below the intended vertebra were resected with the transverse processes. This gave a rather poor exposure of the side of the vertebral body with its pedicle. The lamina and pedicle were removed first and then part of the body. The latter usually had to

be gotten out piecemeal with a curette or gouge. This procedure was difficult because of the inadequate exposure but chiefly due to the severe hemorrhage. In the cases thus operated on the bleeding was profuse and in the majority there was severe or moderately severe shock making it necessary to give transfusions to several of the patients after operation. The second patient operated on, the youngest in the series, succumbed to shock one hour after operation. As soon after removal of the vertebral body as the patient's condition allowed a traction jacket with antero-posterior hinges and a turnbuckle was applied and the greatest possible correction was obtained. A Hibbs spine fusion operation was then done.

The third patient upon whom operation was proposed was a boy of 6 years with a hemivertebra between the third and fourth lumbar on the left side, causing a curve in that direction. This suggested an easier approach to the vertebral body by an incision through the flank, behind the peritoneum. It was made from the twelfth rib at the outer border of the sacrospinalis muscles, downward and forward through the dorsolumbar fascia to the crest of the ilium from the central third of which the muscles were divided. The peritoneum was pushed forward, thus giving a good exposure of the lumbar bodies on that side. It then remained simply to ligate the lumbar vessels above and below the body and to remove the latter with a chisel as far as its junction with the pedicle. There was very little bleeding and no shock. The whole procedure was accomplished in less than one hour.

Twelve days later through a dorsal midline incision the posterior arch together with those adjacent to it, was exposed by subperiosteal dissection, and the arch of the hemivertebra was removed. Although not extremely difficult, this second stage of the operation resulted in more bleeding and was not as easy as the first. The hemivertebral arch usually is united to the one above or below, and sometimes to both which adds another obstacle to its excision after removal of the body. Bridges of bone were turned up and down from the adjacent laminae in such manner that they would interlock when the laminae were approximated.

After both stages of the operation the patient was placed in a posterior shell of plaster previously

¹From the Clinic of the New York Orthopaedic Dispensary and Hospital.

Dr. van Lackum met with an untimely death in an airplane accident on June 30, 1934. All of the operations for removal of vertebra reported in this paper were performed by him. The operations on these patients for spine fusion, etc. after that they were performed by his colleagues.

prepared. A jacket was applied under light traction 9 days after the second operation, and in this a lateral hinge and turnbuckle were incorporated by means of which the jacket was wedged and the space left by removal of the hemivertebra was closed. Fusion occurred in this case without further operation, but in a similar case it was necessary to do a fusion operation later.

Done in this way, the operation is comparatively easy and is free from hemorrhage and shock. It is applicable only to cases of hemivertebra in the lumbar region, and it is important to note in this connection that the only successful cases among these ten were two with lumbar hemivertebrae and one of scoliosis in the lumbar region. The difficulty of exposure and the severe hemorrhage encountered in the dorsal area of the spine make the operation impracticable there.

One patient, a girl 14 years old, with a severe right dorsal curve, had a pneumothorax following removal of part of the ninth dorsal body. This was the only case in which the pleura was damaged. A child 6 years old with a curvature caused by a hemivertebra and who also had an extensive spina bifida in the lumbar region and partial paralysis of the lower extremities showed an increase in the paralysis and evidence of spinal cord pressure after operation for removal of the twelfth dorsal body.

The results of the operations in the 10 cases may be summarized as follows. Two patients with hemivertebrae between the third and fourth lumbar were corrected to the point where their spines were straight and there was no apparent curvature. In the first the curve was reduced from 31 to 9 degrees and in the second it was overcorrected from a left curve of 37 degrees to a right curve of 7 degrees.¹ One 22 year old patient with a marked left lumbar curve was corrected from 30 degrees to 6 degrees by removal of portions of the first and second lumbar bodies. Two other patients obtained substantial reductions in their lateral curves but this was offset by the occurrence of a kyphosis and failure of fusion of the spine at the site of operation. The other cases either were not corrected beyond the condition before operation or subsequently progressed still further. These were all dorsal curves and the failures are attributable to inability to complete the removal of the body or portion of the body because of hemorrhage. One patient died of shock. The average period of observation after operation was 4½ years.

Pseudarthrosis or a defect in the spine fusion at the site of operation occurred in 6 of the 9 cases. An operation for repair was done twice in 2 cases and once in 2 cases. The 2 other patients refused to have another operation. One complains of tenderness at the pseudarthrosis. The other has no symptoms.

A kyphotic deformity developed at the point where the vertebral body was removed in 7 of the 9 patients. It was marked in 5 moderate in 1 and slight in 1. This was in the dorsal cases and was due to anterior rather than the desired lateral collapse.

A brief history of the cases follows.

CASE 1. J. W. No. 53,444, a boy was first seen in the out-patient clinic of the New York Orthopaedic Hospital March 28, 1923 at age of 8 months. Physical examination was negative except for a marked left lateral curve of the spine in the lower dorsal region and a right lumbar curve. X-ray examination showed a hemivertebra of the eleventh dorsal on the left side and a hemivertebra of the second dorsal right. Attempts to correct the curve by plaster jackets preliminary to spine fusion were made in 1923. These were unsuccessful and the curvature increased, associated with a kyphosis. At the age of 3, on July 15, 1924, an operation was performed for removal of the eleventh dorsal hemivertebra. Through a dorsal midline incision the lamina and pedicle of the eleventh dorsal were removed, after which the body on the left side was exposed between the nerve roots, and excised. The Hibbs spine fusion operation was then done between the ninth and tenth dorsal and the twelfth dorsal and first lumbar arches, but not between the tenth and twelfth, in order that the curve might be corrected. Subsequently X-ray examination showed that the eleventh dorsal hemivertebra had been removed and that there was a 52 degrees curve from ninth dorsal to second lumbar. By means of plaster jackets the curve was reduced to 30 degrees, and on October 14, 1924, a second fusion operation was done to unite the arches of the tenth and twelfth vertebrae between which the eleventh had been removed. A jacket was reapplied and he was maintained in plaster until July 1925. In September the curve had increased to 40 degrees and the patient was readmitted and operated on. A wedge was removed from the left side of the tenth dorsal vertebra. This body was approached through a midline incision. Failure of fusion was found between the arches of the ninth, tenth, and twelfth dorsal. A wedge of bone with base to the left was removed at each site of pseudarthrosis. Two weeks after operation a plaster jacket with head piece was applied under traction. The patient was readmitted to the hospital April 27, 1927, for repair of pseudarthrosis. A jacket was applied which caused a pressure sore due to a kyphosis which had developed at site of operation. The operation was performed on September 23, 1927. A narrow crack was found at the apex of the kyphosis and another at the upper end of the fusion area. These were repaired. In April, 1931 the left curve measured 50 degrees and the kyphos 90 degrees. Fusion appeared to be solid.

CASE 2. L. F. No. 82,702, a girl was brought to the clinic of the New York Orthopaedic Hospital when 10 months old because of a deformity of her back noted 3 months previously. She was a well developed healthy baby with a moderate left lateral curve in the dorsolumbar region. X-ray examination showed a left hemivertebra of the twelfth dorsal. She was admitted to the hospital

¹The method of measuring the degree of the curvature in scoliosis is described by Ferguson in "The study and treatment of scoliosis." South M. J. 939, 2216, 2176.



Fig. 1

Fig. 1. Case 3. Roentgenogram before operation, showing left hemivertebra between third and fourth lumbar vertebrae.



Fig. 2

Fig. 2. Case 3. X ray picture taken in hinged jacket after operation. Hemivertebra has been removed.



Fig. 3

Fig. 3. Case 3. Final result 2 years after operation.

and operated on for removal of the hemivertebra on December 7, 1935, at the age of 1 year, 5 months. Through a midline incision the posterior arch of the hemivertebra was exposed subperiosteally. The upper part of the lamina was removed and the lateral and anterior aspects of the body were exposed. The hemivertebral body and part of the body of the first lumbar were removed with a curette and a bivalved plaster was applied. The patient recovered from the operation without shock. X-ray examination after operation showed that the hemivertebra apparently still present, removal evidently having been incomplete. On February 15, 1936, a second operation was undertaken for removal of the hemivertebra. This was done through the scar of the previous operation. Because of the great difficulty in exposing the residuum of the hemivertebral body the one below this (first lumbar) was removed piecemeal. Bleeding made the operation difficult but the patient left the operating table in fairly good condition. A hypodermoclysis was given immediately. She suddenly went into shock and died 1 hour after the operation.

CASE 3. B. B. No. 90,156, a 6 year old boy was first seen in February, 1937. Eight months previously the family physician noted a slight curvature of the spine. An operation for pyloric stenosis was done at 4 weeks of age. He was a well developed and nourished boy. Posture was poor and there was a left lateral curve in the lumbar region. X-ray examination revealed a left hemivertebra between the third and fourth lumbar and a central cleft through the bodies of the fifth, sixth, and seventh dorsal vertebrae. It was decided to remove the lumbar hemivertebra in two stages, the body through a lateral incision in the flank and the posterior arch through a dorsal midline incision. The first stage was done on April 9, 1937. The hemivertebra was united to the body of the fourth lumbar and was chiseled free. It was then removed with the disc between it and the third lumbar. A previously prepared plaster

shell was applied. There was no postoperative shock. The second stage was done on April 21, 1937, 12 days after the first. The lamina, transverse process, pedicle, and small remaining part of the body of the hemivertebra were removed and a Hibbs fusion operation was done between the third and fourth lumbar vertebrae. A posterior plaster shell was applied. There was no shock and the incisions healed by primary union. A jacket with lateral hinges was applied under slight traction 9 days after operation. The jacket was wedged and the space left by removal of the hemivertebra was thus closed, bringing the third and fourth lumbar bodies in contact. The patient was discharged from the hospital, in a bent plaster jacket on May 30. This was removed in September, 1937. X-ray examination in May, 1932, showed a left lumbar curve of 9 degrees instead of the 31 degree curve present before correction. Physical examination showed that the spine was straight and the shoulders and pelvis level. Two brothers of the patient have vertebral anomalies in the form of cleft bodies and ribs of several dorsal vertebrae.

CASE 4. S. D. No. 97,313, a 17 year old girl, applied for treatment of a lateral curvature of the spine at the New York Orthopedic Hospital on January 18, 1937. The deformity first was noticed when she was 12 years old and was treated for years with exercises, massage, braces, and corsets, in spite of which it constantly increased. She had a marked right dorsal curve of 46 degrees, extending from the sixth dorsal to the first lumbar vertebra, with the apex at the tenth dorsal. There was a compensatory left lumbar curve of 34 degrees. Attempts to reduce the curve by jackets applied in the dispensary failed. She was admitted to the hospital and on October 26, 1937 the pedicle and about one-third of the body of the tenth dorsal were removed, through a six inch incision to the right of the midline. The operation was very difficult because of profuse hemorrhage. Her condition after operation was poor and the pulse was rapid and irregular. A transfusion of 700 cubic centimeters



Fig. 4.

Fig. 4. Case 6. Roentgenogram of hemivertebrae between second and third lumbar vertebrae showing the condition before operation.

Fig. 5. Case 6. Roentgenogram taken immediately after operation and before correction, showing removal of

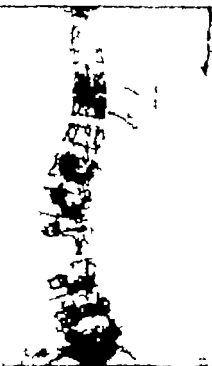


Fig 5

the hemivertebra together with a large part of the third lumbar body.¹

Fig 6. Case 6. X ray picture 3 years after operation, showing overcorrection of the curve and fusion of the bodies.



Fig 6

of blood was given in the evening, after which the patient's condition was much improved. X ray examination 3 days after operation showed the dorsal curve reduced to 36 degrees. A wedging jacket was applied by means of which the curve was further corrected to 24 degrees.¹ On December 7, 1927, 2 months after the first operation, a spine fusion of the ninth, tenth, and eleventh dorsal was done through a window in the jacket. She was discharged from the hospital in a bent jacket, on March 10, 1928. An X ray examination on June 6, 1930, showed that the right dorsal curve had increased from 24 to 61 degrees and that there was a marked kyphos with the apex at the tenth dorsal. In January, 1931, the patient was in good general health and had no pain or fatigue in her back. She was employed as a dentist's assistant. The kyphos had increased markedly since 1928 but more rapidly in the last 18 months, indicating that a pseudarthrosis was present in the fusion area. She refused to have this repaired.

Case 5. T. C. No. 51,871, a girl 9 months old, was admitted to the out-patient clinic of the New York Orthopaedic Hospital on January 6, 1927. She had a right dorsal, left lumbar curve and X ray films revealed a hemivertebra on the left side between the second and fourth dorsal and another at the twelfth dorsal on the left side. There was a spina bifida from the first lumbar to the sacrum. On admission to the ward in January, 1928, she had a fixed left dorsolumbar curve of 50 degrees, with marked tilt of the pelvis, and a valgus deformity of the left foot and equino varus of the right, caused by the spina bifida. Following a blood transfusion to improve her general condition, an attempt was made on February 24, 1928, through a dorsal

incision to remove the arch and body of the twelfth dorsal hemivertebra. Great difficulty was encountered because of hemorrhage, and after removal of the arch and pedicle the excision of the body was abandoned. Two transfusions were given after operation. A second attempt was made to remove the body on June 4, 1928, through a left lumbar incision. Again profuse hemorrhage occurred but the hemivertebra and about half the body of the first lumbar were removed. The wound was packed for 48 hours. Following operation the paralysis of the lower extremities, which was present before operation, was greatly increased and retention of urine developed 4 days later. A wedging jacket after operation failed to correct the curve, and because of persistent paralysis and evidence of a block as shown by lumbar puncture a laminectomy was performed July 11, 1928, from the twelfth dorsal to third lumbar. The lateral articulations were fused at this time. The neurological condition gradually improved after this. Because of the bad alignment of the trunk it was decided to induce a compensatory curve to the right in the dorsal region and to fuse this area. Following a wedging jacket, a fusion operation was done from the eighth to the twelfth dorsal on April 23, 1929. Another fusion operation was done on May 1, 1929, from the third lumbar to the sacrum, in order to maintain the position of the pelvis in relation to the trunk. Repair of a break in the fusion between the eleventh and twelfth dorsal was made on August 12, 1929. Because the curve was increasing this area again was exposed on July 30, 1930 and a wide pseudarthrosis was discovered between the eleventh and twelfth dorsal. An attempt was made to repair it. She recovered sufficiently from her paralysis to walk with crutches, discharged from hospital in January, 1931. The curve originally 50 degrees, measured 73 at that time.

¹For description of the jacket see Hibbs, Riser, and Ferguson. "Scoliosis treated by the fusion operation: an end-result study of three hundred and sixty cases." *J. Bone & Joint Surg.* 1931, xlii, 9.

CASE 6. A. H. No. 99,512, a girl, 3 years old, came to the clinic of the New York Orthopaedic Hospital on April 18, 1937, because of a spinal curvature first noted 4 years previously and which was said to be getting worse. She had had pain for 2 months. Two plaster jackets had been applied without improvement. There was a marked right dorsolumbar left lumbar curve with rotation. Flexibility of the spine was greatly impaired. X-ray examination showed a left hemivertebra between the third and fourth lumbar partly fused to the body and arch of the third lumbar. Removal of the hemivertebra was advised and the operation was performed on May 25, 1938, when the body of the hemivertebra and a portion of the body of the third lumbar were removed through a left lumbar incision. The patient was in slight shock but left the operating room in good condition after an infusion of glucose. On June

9th, 7 days after the first operation the spinous process, lamina, and pedicle of the hemivertebra were removed through a dorsal midline incision. Bleeding was quite profuse when the pedicle was removed but was controlled by packing. The lower part of the lamina of the third lumbar was removed in order to make possible the correction of the curve. One week after operation a wedging jacket was applied, by means of which the curve was overcorrected. The patient was discharged from the hospital in a jacket on July 23, in the hope that the bodies of the third and fourth lumbar would fuse. X-ray examination on September 3 indicated that this had not occurred. On October

9th, a spine fusion of the posterior arches of the first 4 lumbar was done. On May 10, 1939, she had no pain in her back but did have occasional pain in the scar over the anterior part of the iliac crest. Her spine was straight and fusion of the lumbar region seemed solid. She was doing homework. X-ray examination showed the spine straight and fusion very strong. She had a right curve of degrees, as compared with left curve of 37 before operation having been overcorrected.

CASE 7. W. B. No. 60, 67, a colored girl, 15 years old, presented herself at the clinic of the New York Orthopaedic Hospital on February 3, 1936, with a lateral curvature of the spine which was noted 8 years before complaining of pain in her left side. There was a pronounced right lateral curvature in the lower dorsal region with marked rotation of the vertebrae and compensatory curves above and below. X-ray examination showed that the primary curve extended from the eighth dorsal to the first lumbar and that the angle was 60 degrees. Correction by means of plaster jackets, followed by spine fusion, was advised. The patient did not enter the hospital until November 3, 1937. Traction jackets were applied, and the right dorsal curve was reduced to 4 degrees. It was decided that effective correction could be obtained only by partial removal of vertebral body. On December 21, 1937, through a dorsal incision to the right of the midline, a part of the lamina and the pedicle of the tenth dorsal vertebra were removed. The right half of the body of the tenth dorsal was excised and the remaining half was divided transversely. There was comparatively little bleeding. The patient ran a high temperature and leucocytosis. Her operation, and the end of 8 days pus was evacuated from the wound, the culture from which grew staphylococcus aureus. A wedging jacket was applied, by means of which the curve was reduced from 60 to 33 degrees. Through a window in the jacket a spine fusion operation was done from the fifth dorsal to the first lumbar on March 2, 1938. The incision healed by primary union. She was discharged from the hospital, in a jacket, on July 5, 1938, at which time the X-ray film indicated that there was a pseudarthrosis in the fusion area. She was readmitted to the hospital and a repair of the pseudarthrosis, which occurred at the site

of removal of the hemivertebra, was done on September 21, 1938. A kyphos had developed at this level. In January 1939, the curve had increased to 69 degrees. An exploration of the area of fusion was done on January 15, 1939, and it was found to be solid. The second and third lumbar vertebrae were added to the fusion. In November 1939, the angle of measurement was 70 degrees and the kyphos at the site of vertebral removal was considerable.

CASE 8. Y. N. No. 81,305, a girl, 11½ years old, was taken to the New York Orthopaedic Hospital on March 23, 1935, because of a curvature of the spine which had been discovered 1 year before. She was a healthy well developed child with a somewhat severe right dorsal curve with moderate rotation and compensatory curves above and below. X-ray examination showed that the primary curve extended from the sixth dorsal to the second lumbar, with an angle of 53 degrees. Correction and fusion were advised but were refused. She returned to the clinic in July 1937 having had chiropractic treatment and correction. The curvature and rotation had increased markedly the measurement of the curve now being 84 degrees. The family finally consented to operation, and she was admitted to the hospital in December 1937 at the age of 14 years. By means of a wedging jacket, the right dorsal curve was reduced from 84 to 53 degrees, and on February 3, 1938, through a right dorsal incision, an exposure was made of what was thought to be the tenth dorsal vertebra. About one-third of the body was removed, but the posterior cortex could not be gotten out cleanly and less of the body than was intended was removed because of profuse bleeding from the posterior venous sinus. An infusion of glucose was given as the wound was being closed and this was followed by a blood transfusion. A right pneumothorax was present after the operation, indicating that the pleura had been opened. This gradually absorbed and the patient recovered quite promptly from a severe postoperative reaction. X-ray examination showed that the bone had been removed from the body of the sixth rather than the tenth dorsal, as was thought at operation. A wedging jacket was applied on February 18, by means of which correction was obtained to 64 degrees. Because of the patient's general condition and several pressure sores which developed from the jacket, spine fusion was not done until September 28, 1938, at which time the tenth dorsal to third lumbar were included. On November 2, the fourth to tenth dorsal were added at a second operation. An X-ray was taken in June 1939, at which time the curve was 64 degrees and the fusion appeared doubtful between the ninth and tenth dorsal. When the jacket was removed in August, 1939, the curve was 70 degrees. Because of continued pain and X-ray evidence of pseudarthrosis, an operation was done on December 11, 1939, disclosing a wide area of non union between the ninth and tenth dorsal. This was repaired and the patient was discharged from the hospital, in a jacket, on February 25, 1940. In addition to a curve of 76 degrees, she had moderate kyphosis at the ninth dorsal.

CASE 9. B. V. H. No. 65,375, had poliomyelitis when a girl 5 years old. A lateral curvature of the spine was first observed when she was 13 years old. She was seen at the clinic of the New York Orthopaedic Hospital on May 2, 1931 when she was 17. At that time she had a severe right dorsal left dorsolumbar curve with exaggerated posterior deformity. The upper curve extending from the second to the tenth dorsal, measured 45 degrees, and the lower from the tenth dorsal to the fifth lumbar measured 43 degrees. These curves were practically unaffected by traction jacket. She was admitted to the hospital, and double subastragalar arthrodeses and double correction of hip flexion deformities were done in November and December, 1933. By means of jackets with lateral hinge and turnbuckle the



Fig. 7



Fig. 8



Fig. 9.

Fig. 7. Case 9. Lateral curvature before operation.

Fig. 8. Case 9. After operation. Portions of the first and second lumbar bodies have been removed.

Fig. 9. Case 9. X ray picture taken 4 years after operation, showing correction of the curve and fusion of the bodies.

lower curve was reduced to 31 degrees. A spine fusion was done from the tenth dorsal to fourth lumbar on July 23, 1924. One year after operation, following an injury from a fall, X ray examination showed an apparent defect in the fusion between the twelfth dorsal and first lumbar and an increase in the deformity. The spine was explored on March 18, 1926, and a line of fracture through the center of the fusion mass was repaired. In April, 1927 it was noted that her trunk listed to the right and this became more marked throwing her badly off balance. Because of this it was decided to remove part of two bodies on the convex side of the curve, the only possible way in which the deformity could be corrected and balance restored. On May 7, 1928 through a dorsal incision, a wedge was removed from the fused laminae, 1 inch wide at its base on the left side as well as a wedge-shaped piece of the adjacent parts of the bodies of the first and second lumbar vertebrae including about half of each body and the intervertebral disc. Nine days after operation a traction jacket, with anteroposterior hinges, was applied by which the curve gradually was reduced from 30 to 6 degrees. A jacket was worn until June 27, 1929. An X ray examination in January 1932 showed solid fusion of the posterior arches from the tenth dorsal to the fourth lumbar and of the remaining portions of the bodies of the first and second lumbar. She had occasional fatigue but no pain. There was a list of the trunk to the right side but her posture had been greatly improved over that before the removal of the body.

CASE 10. F B No. 16 592, a boy 3½ years old had an attack of poliomyelitis in September 1916. He was seen in the out patient department of the New York Orthopedic Hospital on November 15, 1916 with involvement of the

left lower extremity. It was noted in 1925 that there was a right dorsolumbar scoliosis, which corrected largely with traction. In August, 1926 there was a marked lateral curvature with pronounced rotation. X ray examination showed that this extended from the seventh dorsal to the third lumbar with an angle of 64 degrees. Spine fusion, after correction in a jacket, was advised but the parents refused to have this done. In November, 1927 the curve had increased markedly measuring 80 degrees. He was then 16 years old. He was admitted to the hospital in March, 1928. By means of a hinged jacket the curve was reduced to 31 degrees. On May 10, 1928, an operation for partial removal of the bodies of the twelfth dorsal and first lumbar was performed, through a window in the jacket, by a dorsal approach. Because of profuse hemorrhage the operation was followed by a blood transfusion. Sixteen days later a new traction jacket with anteroposterior hinges was applied. On August 30, the curve measured 18 degrees. It was decided to fuse the spine from the fourth dorsal to the fourth lumbar in several stages. The first included the ninth dorsal to the first lumbar and was done on September 4, 1928. Three weeks later a fusion operation was done from the fourth to the ninth dorsal, and on November 9 the first to fourth lumbar were added. At this time a considerable kyphos was present at the dorsolumbar junction. He was discharged from the hospital on March 17, 1929. The jacket was removed in October 1929. Following this he had pain in the dorsolumbar region and the X-ray picture indicated that fusion was not solid at the first lumbar. The curve measured 23 degrees in April, 1931. There was tenderness at the twelfth dorsal and a marked kyphos. Repair of the pseudarthrosis was advised but the patient refused.

CONCLUSIONS

1 Removal of the body and posterior arch of a hemivertebra is feasible in the lumbar region of the spine and is the only means of correcting a lateral curvature caused by this anomaly. This should be supplemented by a spine fusion operation.

2 The operation should be done in two stages, the first consisting of removal of the vertebral body through a lateral lumbar incision with a

retroperitoneal approach. The posterior arch should then be removed subperiosteally through a dorsal midline incision.

3 This operation may be used also in certain selected cases of severe lateral curvature in the lumbar region not caused by hemivertebrae.

4 Removal of a vertebral body in the dorsal region is impracticable because of the difficulty in exposing the body and the danger from hemorrhage and shock.

THE PERNICIOUS ANÆMIA SYNDROME IN GASTRECTOMIZED PATIENTS¹

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THE intimate relationship between achylia gastrica and the pernicious anæmia syndrome has been demonstrated by many investigators. As further evidence in support of this relationship, the following case is reported

CASE REPORT

Mrs. V. M., white, housewife, aged 39 years, was admitted to the medical wards on May 1, 1939, with chief complaint, vomiting. The onset of her illness was in February 1928, 15 months previously following a miscarriage. At this time, the patient was troubled with frequent vomiting spells, which later became persistent and associated with cramp-like pains in the abdomen. The attacks of vomiting occurred immediately after meals, and were so severe that the patient was unable to retain even fluid. Constipation was marked, there seldom being more than two movements a week. Other symptoms noted were weakness, dizziness, headaches, and a loss of 30 pounds in weight. The significant facts of the past history were four miscarriages, diminished hearing, and occasional generalized twitching of the muscles.

The physical examination revealed a markedly emaciated adult female, hearing diminished in the left ear and tenderness in the left upper quadrant of the abdomen associated with spasm. A small firm mass was present in this region, the shape was indefinite and the borders could not be outlined. The tumor became more evident when the patient was rotated on her right side. In addition to these findings, there was a generalized lymphadenopathy.

The laboratory report is as follows: The urine was essentially normal. The stools showed no blood or parasites. The gastric contents on analysis, following histamine injection, contained no free hydrochloric acid but much food material from the previous day. The blood picture was as follows: the red blood cell count was 4.2 million per cubic millimeter; hemoglobin, 70 per cent (Sahli). The Kahn test on two occasions was 4+. The X ray studies revealed (1) chest negative (2) small vertical type of stomach with marked irregularity of the greater curvature, prepyloric, and stenosis of the antral end. In connection with the history the appearance was suggestive of hereditary syphilis. Fluoroscopic examination showed the isthmus to be completely shut off.

COURSE. The patient received a series of arsphenamine treatments with no benefit. Consequently a partial gastrectomy was performed according to the method of Polya. The pathological report was as follows: Chronic ulcer with vascular granulation tissue base backed by dense fibrosis. Plasma cell and lymphocyte infiltrations. No neoplasm. Highly suspicious of syphilitic ulcer. No spirochetes found.

The patient made an uneventful recovery and felt comparatively well until June, 1931. Following an appendectomy at this time, she again had frequent vomiting spells, epigastric distress, heart burn, and a throbbing sensation in the abdomen. Two weeks previous to her second admission, June, 1931 she fainted. The patient also noticed increasing weakness, pallor, poor appetite, and a loss of 10 pounds in weight. Physical examination at this time revealed a pale, emaciated, adult female, with marked tenderness in the abdomen. The Kahn test was again 4+. A

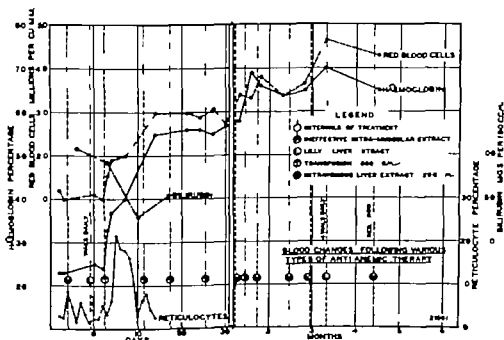


Chart. Red blood cell, hemoglobin, bilirubin, and reticulocyte changes following various types of anti-anæmic therapy

TABLE I

| Date | Red blood cells million per cu mm | White blood cells per cu mm | Hemo- globin per cent (Sahli) | Reticu- late per cent | Treatment | Day of treat- ment | Measurement of red blood cells on 6-14-32 |
|---------|--------------------------------------|--------------------------------|--|-----------------------------|--|-----------------------------|--|
| 6-12-32 | | 1150 | 3 | | Lilly's No 343, 6 mls daily | | Micros 45 M—9% |
| 6-13-32 | | | | | | | 6 6 |
| 6-16-32 | 90 | 3900 | 14 | 3 | Transfused | | 6 7 6 |
| 7-3-32 | 84 | 4750 | 33 | 3.3 | | 3 | 7.5 27.5 |
| 7-8-32 | 90 | 4090 | 17 | 6.3 | | 4 | 8 13 |
| 7-9-32 | | | | 9 | | 5 | 9 20.5 |
| 6-30-32 | | | | 12.9 | | 6 | 9.7 33 |
| 6-3-32 | 99 | 3400 | 40 | 8 | | 7 | 11.5 |
| 6-13-32 | | | | 10 | | 8 | |
| 6-13-32 | | | | 3 | | 9 | 13.5 |
| 6-24-32 | | | | 3 | | 10 | |
| 6-28-32 | | | | 6.9 | | | |
| 6-30-32 | | | | 8 | Oral liver extract discontinued. Intravenous liver extract | | |
| 7-7-32 | | | | 4.3 | | 3 | |
| 7-12-32 | 97 | 4050 | 18 | 8 | | 14 | |
| 7-13-32 | 96 | 4200 | 36 | | 7-13-32 Intravenous liver extract | | |
| 7-18-32 | 84 | 3700 | 36 | | 7-18-32 Intravenous liver extract | 24 | |
| 7-1-32 | 3.97 | 7130 | 35 | | | 7 | |
| 7-14-32 | 74 | 6430 | 37 | | 7-14-32 Intravenous liver extract | 30 | |
| 7-13-32 | 3.30 | 6430 | 38 | | Intravenous liver extract | 30 | |
| 7-20-32 | 3.23 | 8.00 | 69 | | Intravenous liver extract | 45 | |
| 8-6-32 | 3.78 | 1150 | 66 | | Intravenous liver extract | 51 | |
| 8-20-32 | 3.43 | 8.30 | 64 | | Intravenous liver extract | 67 | |
| 8-23-32 | 3.65 | 6830 | 63 | | Intravenous liver extract | 8 | |
| 8-27-32 | 4.65 | 9200 | 70 | | Intravenous liver extract | 60 | |
| 8-27-32 | 30 | 5700 | 65 | | Intravenous liver extract + F | 30 | |

gastric analyses with histamine hydrochloride showed no free acid. A blood count and film at this time were typical of pernicious anemia. The red cell count was .03 million per cubic millimeter, the white cell count was 3500 per cubic millimeter, the hemoglobin was 3 per cent (Sahli) the differential leucocytosis was as follows: polymorphonuclear neutrophils, 59 per cent; eosinophils, 3 per cent; large lymphocytes, 34.5 per cent; small lymphocytes, 3.5 per cent; monocytes, 3 per cent; and hemoblastocytes 0.5 per cent. The measurement of the red cells showed a marked variation in the size of the cells, with 55 per cent of the cells larger than 7.5 micron. The bilirubin was increased in amount, being .17 milligrams per 100 cubic centimeters of blood. A summary of the blood findings is shown in the chart and Table I.

The patient was given a blood transfusion immediately because of her serious condition, and then given liver extract therapy orally and parenterally with a response characteristic of pernicious anemia. For 3 days, 6 vials of liver extract (Lilly No 343) were administered daily and following this, intravenous treatment was instituted at weekly biweekly and monthly intervals. The patient has

shown steady improvement, and, when last observed, her blood picture was as follows: red blood cell count, 4.30 million per cubic millimeter; white blood cell count, 3100 per cubic millimeter; and hemoglobin, 65 per cent (Sahli).

In Table II is listed a summary of the findings from the cases reported in the literature concerning the association of gastrectomy and a pernicious anemia syndrome. In all there were 23 cases, including ours. Operation was performed on 9 occasions for ulcer of the stomach, on 10 occasions for malignancy and on 4 occasions for questionable but highly probable syphilis of the stomach. The type of operation varied. Total and partial resections were common and in 4 instances gastrojejunostomies were performed. Anemia developed in from 5 months to 15 years following the operation. Poole and Foster reported a case with a red count of 550,000 per

TABLE II

| No. | Author | Age | Lesion | Operation | Interval | Red blood cell count | Hemo-globin per cent | Treat-ment* | Cord changes |
|-----|------------------------|-----|------------|--------------------|--------------|----------------------|----------------------|-------------|--------------|
| 1 | Moyalbaa | 43 | Malignancy | Gastrectomy | 3 yrs. 8 mo. | Severe | anæmia | — | — |
| 2 | Hartman | 58 | Malignancy | Gastrectomy | 3 yrs. | 1 40 | 48 | — | — |
| 3 | Ellis | 56 | Malignancy | Gastrectomy | 3 yrs. | 00 | 40 | — | + |
| 4 | Erdtman | 57 | Malignancy | Gastrectomy | 6½ yrs. | 1 80 | 30 | — | — |
| 5 | Hochrein | 55 | Malignancy | Gastrectomy | 8 yrs. | 1 50 | 40 | + | — |
| 6 | Morawitz | 56 | Malignancy | Gastrectomy | 8 yrs. | 1 50 | 34 | + | — |
| 7 | Morawitz | 60 | Malignancy | Gastrectomy | 6 yrs. | 80 | 10 | + | — |
| 8 | Ungley | 41 | Malignancy | Gastrectomy | 5 mos. | 3 81 | 95 | + | — |
| 9 | Berger | 60 | Malignancy | Gastrectomy | 6 yrs. | 85 | 30 | + | + |
| 10 | Coka | — | Malignancy | Gastrectomy | — | — | — | — | — |
| 11 | Campbell and Casybears | — | Ulcer | Gastrojejunostomy | 8 yrs. | — | — | — | — |
| 12 | Glarvill and Hurst | 34 | Ulcer | Gastrojejunostomy | 3 yrs. | 1 68 | 44 | + | + |
| 13 | Fahley and Kiloer | 43 | Ulcer | Gastrojejunostomy | 3 yrs. | 3 60 | 65 | + | — |
| 14 | Wilcox | 33 | Ulcer | Gastro-enterostomy | 7 yrs. | — | — | — | — |
| 15 | Delore | 43 | Ulcer | Gastropylorctomy | 5 yrs. | 68 | 17 | — | + |
| 16 | Danzig | 41 | Ulcer | Gastrectomy | 7 yrs. | 1 80 | 40 | + | + |
| 17 | Hochrein | 56 | Ulcer | Gastrectomy | 9 yrs. | — | Severe anæmia | + | — |
| 18 | Scheidel | 30 | Ulcer | Gastrectomy | 6 yrs. | 63 | — | + | — |
| 19 | Hauptner | — | Ulcer | Gastrectomy | 3 yrs. | 30 | 50 | + | — |
| 20 | Poole and Foster | 30 | Syphilis | Gastrectomy | 3 yrs. | 50 | 80 | + | — |
| 21 | Rowlands and Simpson | 38 | Syphilis | Gastrectomy | 6 yrs. | 3 70 | 40 | + | + |
| 22 | Crab | — | Syphilis | Gastrectomy | — | — | — | — | ? |
| 23 | Goldhamer | 30 | Syphilis | Gastrectomy | 3 yrs. | 1 0 | 35 | + | — |

*The red blood cell count in millions per cu. mm. before treatment was tabulated.

**Various types of liver liver extract (orally or parenterally) and Venticula.

cubic millimeter, Scheidel and Delore reported two other cases with counts of 600,000 cells per cubic millimeter. Six of the cases had cord changes. The other symptoms most commonly noted were those associated with anemia—weakness, tiredness, ease of fatigue, pallor, dyspnea, and palpitation. Of the 14 cases treated with liver therapy, orally or parenterally, a response was obtained exactly like that of any uncomplicated case of pernicious anemia.

According to Poole and Foster, anemia occurs in all gastrectomized patients if they survive long enough. Rowlands and Simpson concluded that the occurrence of primary anemia after gastric operations was not a mere coincidence. Since only one case has been reported with an anemia occurring within a period of 24 months after operation, and several cases of gastrectomy have been reported with no anemia occurring within this interval, the time element must be a most important factor in the development of the anæ-

mia. A patient may then have the predisposing factors of pernicious anemia for at least 6 to 24 months before any of its characteristics manifest themselves clinically.

It is now necessary to answer the question of whether the anemia associated with gastrectomy is the result of the operation, or whether it is an incidental complication. Carcinoma of the stomach as well as syphilis has been reported to cause blood pictures similar to that of pernicious anemia. In the previous reported cases as well as in our own, either no anemia was noted previous to the operation, or it was of the secondary type. Since our patient had syphilis for a long period of time presumably sufficient to produce an anemia, and yet had none it is reasonable to conclude that the present anemia is the direct result of the gastric resection. However, further proof is necessary before a definite statement can be made.

The development of pernicious anemia following gastrectomy appears to be further evi-

dence in support of the theory that some function of the stomach is a factor in the prevention of this malady. Any agent which would destroy this function, whether it be disease or the removal by operation, would give the same resulting blood picture—that of pernicious anemia.

From a study of the blood findings, it is apparent that with liver therapy the red cells have returned to a normal level and have been properly maintained. However the hemoglobin still remained deficient. This is suggestive of the fact that there is also a disturbance of the iron metabolism as a result of the gastrectomy. Secondary anemia has been produced experimentally on several occasions by Ivy in gastrectomized dogs. Clinically the relationship between iron deficiency and achlorhydria has often been described in the syndrome "chronic microcytic anemia" or "simple achlorhydric anemia." The results of this case, as well as that of Morawitz's case, would seem to be in accordance with the experimental and clinical findings discussed.

SUMMARY AND CONCLUSIONS

1. A patient with chronic gastritis, probably syphilitic, who developed symptoms indistinguishable from pernicious anemia 2 years following gastrectomy is described.

2. Regardless of the initial lesion in the stomach or the type of resection performed, the blood picture and symptomatology of pernicious anemia may develop after a latent period of 5 months to 15 years following the operation.

3. The anemia resulting from gastrectomy responds satisfactorily to liver therapy.

4. A possible relationship between iron metabolism and normal gastric function is suggested.

Since this paper has been written, Rowlands and Simpson, and Ungley have published similar data. Their additional cases have been incorporated in the statistics of this paper.

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PHENYL MERCURY NITRATE

ITS CLINICAL USES IN GYNECOLOGY, A PRELIMINARY REPORT

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RECENTLY Weed and Ecker reported on the use of phenyl mercury nitrate and related compounds as disinfecting and antiseptic agents.¹ They found that phenyl mercury nitrate combines with a very high bactericidal potency a relatively very low local and systemic toxicity for animals and for man. Its effectiveness is not impaired by the presence of tissues or tissue juices, it is but very slightly irritant on local application to wounds and most mucous membranes, it has no odor or color and does not stain, it does not corrode surgical instruments.

Accordingly, at the suggestion of Professor E. E. Ecker we undertook a study of this compound limited to the treatment of infections in the vagina and cervix. The phenyl mercury nitrate for this investigation was supplied by Drs Weed and Ecker.

This series includes 70 consecutive cases of infections in these areas which were treated as indicated below.

As there was no previous clinical work with this antiseptic agent reported it was thought advisable to begin the treatment with very high dilutions concentrating the product as conditions warranted.

In this report it is to be noted that no attempt was made to select certain types of cases. All consecutive patients seen by the author showing a vaginal or cervical discharge were treated with phenyl mercury nitrate.

PROCEDURE

The following is an outline of the standard procedure used. Upon separation of the labia, the urethral orifice was exposed and a smear of the urethral secretion (if present) was taken routinely. The vagina was then opened with the usual bi-valve speculum and the cervix was exposed. A cervical smear was then made. Subsequently the entire vagina was cleansed with dry absorbent cotton balls and the cervical canal wiped clean with a dry cotton applicator. Phenyl mercury nitrate was then instilled into the cervical canal by means of a cotton applicator and it was held *in situ* while a cotton ball saturated with the medication was used to swab out the vagina thor-

oughly. The applicator was then removed and a tampon the distal end of which was saturated with phenyl mercury nitrate was inserted. The patient was instructed to remove the tampon after 24 hours and then to begin the daily douche.

Dilutions of 1:25,000 and 1:12,500 were used at first, but it was soon evident that lower dilutions could be used with safety. Continued experimentation afforded sufficient evidence that the optimum results were obtained by using a 1:1,250 solution, which, according to Weed and Ecker, is the saturation point for phenyl mercury nitrate in water.

Originally the patients were directed to use a daily douche in connection with this treatment consisting of a teaspoonful of sodium bicarbonate to a quart of moderately warm water. Instructions were issued to each patient to avoid the use of salt in the douche in view of the resultant relatively insoluble phenyl mercury chloride which would be formed from the nitrate in the presence of excess chloride. After some experimentation, it was found that 1 gram of phenyl mercury nitrate could be dissolved in 100 cubic centimeters of pure glycerine and so dispensed by the outpatient pharmacy. One dram of this solution thoroughly mixed with a quart of water produced about a 1:25,000 dilution which could be used as a douche.

The first 3 cases treated received phenyl mercury nitrate in a dilution of 1:25,000 and were instructed to use the alkaline douche. In the succeeding 9 cases the patients received the medication in a dilution of 1:12,500 with the aforementioned bicarbonate of soda douche. In the 58 remaining cases a dilution of 1:1,250 was used. In 5 of these, during one phase of the treatment, phenyl mercury nitrate in a dilution of 1:750 in 10 per cent alcohol was used in an attempt to determine the results with a more concentrated solution. The use of the 1 per cent glycerine solution diluted to 1:25,000 in water as a douche was inaugurated sufficiently early in the course of the study to permit its use in 48 patients in conjunction with the 1:1,250 instillation.

DIAGNOSES

In 13 cases the condition was clinically found to be acute gonorrheal endocervicitis and the diag-

noids was substantiated by laboratory findings. In 8 cases the diagnosis was acute gonorrheal endocervicitis clinically but it was not substantiated by the laboratory. Three patients with vaginitis were treated, one due to the persistent use of hot douches, the second to the irritation produced by a pessary with subsequent secondary infection, and the third, that of a child 3 years old with an acute gonorrhea. One patient with a postoperative rectovaginal fistula responded to treatment with sufficiently interesting results to warrant devoting a paragraph to an outline of the history which will be found below. Two patients with *Trichomonas vaginalis* were treated with phenyl mercury nitrate among other medicaments. One patient with an incision and drainage of a Bartholin abscess with the instillation of phenyl mercury nitrate is to be noted.

The 43 remaining cases consisted chiefly of various forms of endocervicitis associated with a host of other conditions referable to the pelvis, ranging from chronic cervicitis as the result of old lacerations to chronic ulcerative endometritis, the result of radium implantation.

Thirty-six of the 70 cases received some form of treatment prior to beginning the use of phenyl mercury nitrate. It is not in the province of this paper to go into any detailed comparison of phenyl mercury nitrate with other antiseptics. It is essential, however, that the reader in evaluating these results, should know in which cases other forms of treatment had been used. In 34, phenyl mercury nitrate in one or another of the dilutions was the initial and only treatment used.

In all cases smears were taken and a notation made on the dispensary chart of the clinical picture with particular reference to the color, consistency, amount, and odor of the vaginal discharge. Subsequent records embodying these details were made at the time of each visit.

SPECIFIC ENDOCERVICITIS

Of 21 cases of definite clinical gonorrheal endocervicitis, a large number of the patients had been resistant to various other forms of treatment. Subsequently these patients were treated with phenyl mercury nitrate according to the method outlined. Without one exception each patient reporting back to the dispensary within 3 to 7 days indicated that her discharge had lessened or disappeared entirely and that she felt very much better. Examination, however showed that while these patients were subjectively improved and no discharge was in evidence to them, objectively the improvement at the second visit was not so pronounced as they indicated.

In other words, one application of phenyl mercury nitrate could not and did not completely relieve the patient. Upon inspection, however it was evident that the amount of the discharge was distinctly reduced. It is safe to say that the reduction in quantity amounted to 50 per cent or more. It was the rule to instruct all our patients not to douche on the day they returned for treatment. What to us was of prime importance was the fact that the color and consistency of the discharge had changed from a thick greenish-yellow foul-smelling leucorrhoea to a milk white, odorless, and comparatively thin secretion. This change in the discharge was seen in our very early cases, and it became very much more pronounced in those patients who had the benefit of phenyl mercury nitrate as a douche.

These cases of gonorrheal endocervicitis received treatment with phenyl mercury nitrate for periods varying from 2 to 12 weeks and were subsequently cared for with whatever adjuvant treatment the condition then indicated. In other words, the phenyl mercury nitrate was used to clean up the secondary infection, to eradicate the primary infection, and then to maintain the areas clinically free from infection while other treatment was used to heal associated conditions, e.g. silver nitrate or the actual cautery for cervical erosions.

A typical case as an example of this group is given herewith:

M. M., age 23 years, was referred to the gynecological service on February 10, 1932 from the postnatal division of the obstetrical service, because of a persistent discharge with positive smears for gonorrhea. Upon examination she showed a typical acute inflammatory process involving the cervix with a surrounding vaginitis. The discharge was yellow green in color and comparatively thick. The fundus was still slightly enlarged, undergoing involution. The adnexa were negative. Smears taken on her first visit showed gram negative intracellular diplococci. Treatment was instituted at once consisting of phenyl mercury nitrate instillations three times weekly and daily douches. On the third visit, 6 days later, the patient volunteered the information that her discharge had disappeared and that she felt "wonderful." Examination at this time revealed a very definite lessening of the inflammatory process, as well as a marked decrease in the amount of the leucorrhoea, with clinical evidence of the change in the character of the infection. Treatment was continued without interruption for another 2 days with excellent results. Gradually the instillations were given at longer intervals, and finally discontinued, when, on March 25, 6 weeks after her first visit to the dispensary the discharge had completely disappeared. Subsequently silver nitrate was used to treat an associated cervical erosion, and the patient was discharged as cured on April 20, 1932, with repeated negative smears and negative pelvic findings.

VAGINITIS

Similar good results were obtained in the treatment of the 2 cases diagnosed as vaginitis, one

from the irritation due to a pessary with secondary infection, and the other to the persistent use of hot douches. In these cases rapid early improvement was noted and the phenyl mercury nitrate douches were continued until complete eradication of the secondary infection followed. The third case of vaginitis in our series was one of gonorrheal origin in a child of 3 years. She received only two treatments at our hands with beneficial results. Continued care of this case was prevented by the transfer of the patient to another dispensary.

BARTHOLIN ABSCESS

The results obtained in the case of a Bartholin abscess of right labium are as follows:

This patient had the abscess incised, drained, and packed with iodoform gauze on December 5, 1931. In the dispensary. The following day it was noted that the packing apparently had been lost and the abscess was still draining. About 5 cubic centimeters of the 1:1,250 solution of phenyl mercury nitrate was instilled directly into the cavity by means of a blunt syringe. Because of an associated endocervicitis the patient was given the phenyl mercury nitrate douche for daily use. Two days later the cavity appeared absolutely clean. The combined treatment was repeated and continued until December 30, 1931, when the wound was completely healed and the endocervicitis had cleared up. The patient was discharged as well.

RECTOVAGINAL FISTULA

The following is the case of postoperative rectovaginal fistula mentioned above in which phenyl mercury nitrate was used with beneficial results:

This patient came to our attention in the dispensary on February 27, 1932, after having had a bilateral vaginal incision and drainage for tubo-ovarian masses at two different operations 3 weeks apart, and, 1 month later, a supra-cervical hysterectomy. Shortly after the last operation a rectovaginal fistula was discovered and she was referred back to the dispensary for treatment. After many futile attempts were made to keep the area clean with various antiseptics at our command, we decided to employ phenyl mercury nitrate. We felt that herein was an ideal case in which to try an antiseptic which might keep the area around the fistula sufficiently clean to allow it to heal. With this in mind we started 1:1,250 phenyl mercury nitrate instillations three times weekly into the cervix and the vagina, and advised the twice daily use of the phenyl mercury nitrate douche. Examination on her first visit revealed a foul greenish-yellow discharge mixed with feces coming from a fistulous opening about $\frac{3}{4}$ inch in diameter just below the cervix. One week after the first treatment it was noted that the discharge was white in color for the first time. Some three weeks later the fistulous opening was found to be thoroughly clean with no evidence of any secondary infection. At this time the instillation of phenyl mercury nitrate was discontinued and the edges of the fistula were touched up with silver nitrate to stimulate epithelial growth. Meanwhile the douches were continued once instead of twice daily. Repeated examinations thereafter revealed a gradual closing of the fistula, while the discharge had completely stopped, and on March 30, 1932

the fistula was found to be definitely closed. At subsequent visits the slight cervical erosions present were treated with silver nitrate and the patient was discharged as well on June 16.

TRICHOMONAS VAGINALIS

Among the forms of protozoan life resistant to ordinary antiseptics is the organism known as *Trichomonas vaginalis*. In our particular series we had two cases of vaginitis due to this organism which had received courses of treatment with every antiseptic available to us, with very poor results. To determine the efficacy of phenyl mercury nitrate, these 2 patients were treated with this medication in both its forms, as outlined herein. Our results were uniformly poor, establishing to our satisfaction that phenyl mercury nitrate in the saturated solution with the use of the 1:25,000 douche has no inhibitory effect, *in vivo*, on the growth of the protozoan, *Trichomonas vaginalis*.

NON-SPECIFIC ENDOCERVICITIS

The final series of cases consisted of a group of 42 patients having endocervicitis of a non-specific origin with or without other associated pelvic conditions. These patients received phenyl mercury nitrate in various dilutions by the method described. Twenty-six of these, after receiving the instillations, were instructed to use the bicarbonate of soda douche. The 16 remaining used the phenyl mercury nitrate 1 per cent glycerine douche.

The reports from this group of patients returning on the second visit varied from that of a change in color and decrease in amount of the discharge to those reporting its complete absence. The chief factor of interest in this group is the fact that phenyl mercury nitrate reduced the usual secondary infection to be found in the vagina and cervix in this class of patients permitting the use of whatever adjuvant treatment the associated conditions warranted. A fairly large number of these patients were referred to the House service for various operations limited to the pelvis. Others received the additional necessary treatment in the dispensary.

We were struck by the clinical fact that phenyl mercury nitrate could within 24 to 48 hours change the character of the infection. Whereas we were unable in every case in this group to clear up its source we were fortunate in being able to reduce the discharge. Many of these patients having such associated conditions as salpingitis in various stages derived great benefit from the use of the hot daily douche with phenyl mercury nitrate.

HIGHER CONCENTRATIONS

In an attempt to obtain a more concentrated solution of phenyl mercury nitrate it was dissolved in 20 per cent alcohol producing a 1:750 solution. Five of our patients having an endocervicitis of a non-specific origin in the earlier part of the investigation were treated with this increased concentration. Each patient after two instillations and tamponing showed a gray film on the cervix only, which, when rubbed came away. This we took to be a chemical burn produced by the phenyl mercury nitrate. After 1 week's rest, during which time these patients received one instillation of dry boric powder the burns healed. This concentration of phenyl mercury nitrate was then discontinued and the saturated aqueous solution (1:250) substituted with the usual favorable response given to this medication in this dilution.

SUMMARY

A series of 70 cases of infections of the vagina and cervix treated with phenyl mercury nitrate is reported.

Favorable response to the use of this antiseptic was invariable in all the conditions encountered, both specific and non-specific, except when the *Trichomonas vaginalis* was the inciting agent.

The character of the infection can be changed often with but a single application of this antiseptic with resultant rapid amelioration of the condition.

The results of the use of phenyl mercury nitrate in this series ranged from rapid and complete clinical recovery to improvement sufficiently marked that adjunct treatment could be successfully applied.

In effective concentrations, both as local application (1:1,500) and as douche (1:15,000) phenyl mercury nitrate is non-toxic; it is practically non-irritant to the vaginal mucous membrane. It is effective in the presence of thrush. It is odorless, colorless, and does not stain. It does not corrode surgical instruments; its solutions show no apparent deterioration on standing.

Phenyl mercury nitrate, being a highly effective bactericidal agent of the characteristics indicated appears to offer encouraging possibilities in gynecology.

ADDITIONAL CASES

Since this paper was submitted for publication a series of 30 additional cases, treated with phenyl mercury nitrate,

has been completed. This work was done in a semi-public institution for indigent girls, in Cleveland. All the females were subjected to routine vaginal examinations; smears for gonococci were made and blood Wassermann reactions were determined as part of the venereal disease control program of the Cleveland Health Department. The author was afforded the privilege of doing this work for a 4 month period beginning October 18, 1935. As these patients were institutionalized throughout the period of treatment, these results afforded an excellent check on the series of dispensary patients previously studied.

The individuals ranged in age from 13 to 37 years. All those selected for treatment showed some form of endocervicitis, 19 being specific, clinically and/or microscopically, and eleven non-specific. Of the 30 cases, 17 had had some form of treatment previously for periods of up to a year or more. The 13 remaining were new lesions examined for the first time.

The method used was identical with that outlined above. These patients were treated twice a week by the author and were instructed to use the phenyl mercury nitrate douche at stated intervals, usually daily. The results were uniformly good, with but a single exception, in the latter case an endocervicitis of specific origin was cleared up, but because of a subacute bilateral salpingitis, the discharge persisted.

We were gratified to note the ease with which the treatment was carried out, causing little disturbance in daily routine.

In order to learn whether the repeated daily use of phenyl mercury nitrate resulted in the absorption of significant quantities of mercury, which among other effects, might prove deleterious to the kidneys, Miss N. E. Schreiber of the Department of Pharmacology, Western Reserve University determined for us, by a highly sensitive microchemical method, the mercury content of 24 hour urine specimens of three individual cases treated at this institution. These patients were chosen for this purpose because they had used the douche daily for the longest period of time, namely 6 weeks. The urine specimens were collected 24 hours following cessation of all treatment. Miss Schreiber reported as follows:

Chemical analysis of three specimens of urine received December 1, 1935 for the presence of mercury shows as follows:

| | Volume | Total metallic mercury |
|-------|-------------|------------------------|
| M. H. | 1,200 c.cm. | Trace—about 0.008 mgm. |
| J. J. | 1,860 c.cm. | 0.035 mgm. |
| H. W. | 1,600 c.cm. | 1.104 mgm. |

While this data is not conclusive, in that no information is available as to the quantity retained in the body or as to the fecal excretion, nevertheless, judging from the very extensive studies of Schreiber, Solomons, Cole and associates¹ on the clinical excretion of mercury the figures given here may be considered to represent an entirely negligible output. Where significant quantities of ionized mercury are absorbed, as in laetic therapy, the urinary excretion of the metal is very much greater than that reported above.

¹Schreiber, T. M. *Lectures*. 326, *Journal of Pharmacology*, 4th ed., 1932.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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AUGUST 1933

ACID OR ALKALI IN THE TREAT- MENT OF URINARY TRACT INFECTIONS

FOR many years it has been believed that changes produced in the reaction of the urine were an important factor in the treatment of urinary infections. On the other hand, opinion has periodically and more or less constantly vibrated between the acid and the alkaline extremes suggesting no very fundamental convictions in regard to this influence.

For a long time the school of thought which advocated switching the reaction of the urine from acid to alkaline chiefly in infection due to the colon bacillus group and particularly in pediatric practice, held sway. This was based upon the view that an organism which had become accustomed to growth in an acid medium would grow less satisfactorily in an alkaline one. While this was bacteriologically true, it left out of account the ability of the organism rapidly to adapt itself to the changed reaction, and probably neither the degree of acidity nor the degree of alkalinity ever

seriously affected the vitality of the organism.

Within the last two years, work by Helmholz and also by Clark has, I think, put this question on a secure basis and demonstrated beyond peradventure that acidification pushed to high limits is a very important and perhaps the most important single factor in the treatment of these conditions. Helmholz worked with children, Clark with adults. Their results agree in principle and differ in detail. The most important of their contributions was the clear demonstration that acidity of the urine produced by a ketogenic diet will sterilize the urine more certainly and more rapidly than when produced by drugs. In children the sterilization produced by ketosis can occasionally be arrived at within forty-eight hours. In adults the time required is longer and the result less spectacular. In children it has been possible to sterilize the urine even in the presence of incomplete drainage of some portions of the urinary tract, a feat which as far as I know has never been heretofore achieved. In adults the combination of ketosis with drugs tending to produce acidity, particularly ammonium chloride and ammonium nitrate, is commonly necessary. In children such a combination is less often required. The important thing is that acidity of high grade should be certainly, and if possible rapidly produced. This degree of acidification can be satisfactorily determined only through the estimation of the hydrogen ion concentration which should be reduced to at least 5.5 and preferably to 5.

The question of whether it is necessary to combine with this treatment the use of urinary antiseptics such as methenamine must be left

for the future to decide. Certain it is that this group of formaldehyde containing drugs is worthless except in a strongly acid urine. It may possibly prove to be true that acidification alone if skillfully handled may have sufficient power without the assistance of formaldehyde.

Old notions die hard and it is still widely believed that an acid urine in and of itself produces irritation. Acting upon this assumption alkalies are frequently given to relieve pain. The work mentioned, and particularly that of Clark, has convinced me that acidity in and of itself is probably incapable of producing symptoms, while on the other hand, many a patient with tremendous frequency and a neutral urine has been promptly relieved by making the urine sufficiently acid. I have grave doubts whether there is any indication for giving an alkali for the relief of pain, and it is certain that such administration will seriously handicap the control of infection. It is my best guess that the day of the alkali in the treatment of urinary tract infection is over.

In order to get results a definite plan must be followed. The organism causing the infection must be known from the start, the hydrogen ion concentration of the urine when the patient comes under observation must be recorded, diet and drugs must be used to the extent necessary to reduce the hydrogen-ion concentration to the neighborhood of 5 and this level of acidity must be maintained if possible until the urine is known to be sterile. Many a clear urine contains the germs of disaster. Nothing short of sterilization can be accepted as a criterion of cure. Most failures are due to three causes: failure to identify the organism causing the condition, failure to produce a sufficient degree of acidity and finally failure to sterilize the urine before stopping treatment.

HYON CATOR

SEPSIS, ANTISEPSIS, AND ASEPSIS

THE outbreak of the World War found the medical profession entirely unprepared to cope with the gigantic problems confronting it. The unprecedented number of wounds, as well as the severity of the trauma inflicted by high explosive shells, presented a problem which was theretofore unknown.

Practically all wounds received during 1914-1915 were infected, i.e., pus producing microorganisms, also tetanus and *Bacillus welchii* were usually present. The devitalization of tissue involving the shell tract was allowed to remain without surgical excision. The antiseptics commonly used such as iodine, bichloride of mercury phenol, etc., failed to prevent infection or cure or arrest it once it became established. It was not until after thorough excision of devitalized tissues, followed by chemical sterilization with sodium hypochlorite 0.5 per cent solution as advocated by Carrel that it was possible to do a secondary suture with any degree of success. Primary and secondary sutures were practically unknown during the early years of the War most all wounds healing by granulation.

Conditions were chaotic in so far as methods of treatment were concerned. There were two schools of thought which, more or less, bitterly opposed the other one school advocated the use of salines to the exclusion of antiseptics and the other advocated antiseptics.

The treatment of wounds, compound fractures, osteomyelitis etc. requires sound surgical procedure and judgment. A scrupulous asepsis followed by the intelligent use of a physiological solution of sodium hypochlorite, 0.5 per cent in combination with a hypertonic saline solution, is the best known treatment to prevent infection and to abort it when

once present. These conclusions were personally confirmed to the author by the Surgeon Generals of the American and British armies and by the Consulting Surgeons of the French and Italian armies.

The clinical evidence is so conclusive that we are at a loss to account for the general lack of interest and failure to adopt a method which has been proved by laboratory and clinical experience to be superior to other forms of treatment.

Foster has reported treating by débridement followed by the Carrel method, 304 consecutive cases of compound fractures of the long bones over a period of 15 years. In this series, there were 2 deaths (1 at the end of 4 weeks and the other at the end of 6 months), there was one amputation but not one infection.

Barone, in 77 cases (septic operations and puerperal sepsis) in which treatment was instituted within the first 72 hours, reports a mortality of 10 per cent. In this series, with few exceptions, the infection was due to hæmolytic streptococcus.

Despite such convincing evidence as to the value of a physiological antiseptic, which is non-irritating and non-caustic, we are confronted by those who advocate the use of

maggots and vaseline gauze in wounds, compound fractures, and osteomyelitis. Needless complications, including amputations and deaths, result from such ill advised procedures. Certain advocates of these methods make an appeal from the standpoint of results (?), maintaining that the laboratory and scientific viewpoint based upon laboratory findings, should be disregarded. However, results based upon personal opinions without necessary controls or comparisons, are usually very misleading and incorrect. Not infrequently, patients recover in spite of the treatment rendered.

The pages of medical literature reek with unscientific practices and useless antiseptics. There is no antiseptic known which can be used to the exclusion of sound surgical principles and practices. One wonders how long sepsis following the use of worthless antiseptics, will be condoned when methods are available to prevent it. The surgeon can no longer "alibi" himself by charging the omission and commission against the operating room nurse, the innocent catgut, etc.

Notwithstanding the extravagant claims made for many popular methods, the proved teachings of Pasteur and Lister do and will prevail.

WIL O'NEILL SHERMAN

MEMOIRS

JOHN CHALMERS DA COSTA

1863-1933

J CHALMERS DA COSTA truly a Philadelphian the son of George T Da Costa a litterateur and bibliophile, was born on November 15 1863 in Washington where his parents were temporarily located. His mother was Margaretta Beasley from Beasley's Point New Jersey He received his early education at the Friends Central School and was graduated from the Towne Scientific School of the University of Pennsylvania in 1882 He was graduated from Jefferson Medical College in 1885 his preceptor being his uncle, Dr John C Da Costa, known familiarly as Uncle John." J Chalmers was referred to as "Jack" and his cousin Dr John C Da Costa Jr who was of dark complexion as 'Black Jack.

Dr Da Costa served thirteen months as an interne at the Philadelphia General Hospital, after which he was appointed assistant physician to the Insane Department of the same institution and during this time contributed several papers on insanity

In 1887 he became one of Chapin's assistants in the Pennsylvania Hospital for the Insane. He engaged in private practice in the same year and was appointed assistant demonstrator of anatomy at the Jefferson Medical College, and one of the clinical assistants of Dr Samuel W Gross. His successive advances at Jefferson were assistant demonstrator of surgery demonstrator of surgery chief of surgical clinic, clinical professor of surgery in 1896 professor of principles of surgery in 1900 Dr Da Costa was the first incumbent of the Samuel D Gross chair of surgery which was endowed by Maria Gross Horwitz (daughter of Dr Gross) in 1910 which he held until his death

He was attending surgeon to the Jefferson Hospital and long a surgeon to the Philadelphia Hospital later he served as consulting surgeon to the Philadelphia General Hospital, St. Joseph's Hospital and Misericordia Hospital and for many years was surgeon to the Pension Fund of the Philadelphia Fire Department.

He was a member of the American Philosophical Society American Surgical Association Society of Clinical Surgery, College of Physicians of Philadelphia, Pathological and Neurological Societies of Philadelphia, the Philadelphia Acad



J Holmes da Costa:-

emy of Surgery, associate member Society of Gynecology and Surgery of Baltimore, member of the Société Internationale de Chirurgie, the Historical Society of Pennsylvania, formerly Commander U.S.N.R.F., etc.

He loved to teach and his hearers were impressed with his foundation in anatomy, his knowledge of surgery his familiarity with history, his frequent quotations from literature, and his inimitable manner in presenting a subject. Jack Da Costa always was at his best before a large audience. Only those who saw him before he became incapacitated in 1922 will remember his characteristic attitude while conducting a diagnostic clinic for the students, with amphitheater filled to capacity the clinic floor and doorway crowded with visiting physicians, confrères, assistants, and former students. First standing to one side of the "platform" with arm resting on the rail and one foot crossed in front of the other, then walking across the floor with body vibrating and knees bending he spoke giving clear systematic, unmistakable facts which left an indelible impression.

He was the idol of the medical students, their admiration was spontaneous. He appealed to the imagination, aroused enthusiasm, and stimulated effort.

As an author his name will live for centuries. In 1894 the first edition of his *Manual of Modern Surgery* was published, the tenth edition appeared in 1937. The last revision was accomplished with much difficulty while he was ill and in great pain. It is one of the most widely known and extensively used textbooks. In the same year he prepared another book for publication entitled *The Papers and Speeches of John Chalmers Da Costa* dedicated to Dr. Harvey Cushing. Many, but not all of his best speeches are contained in this volume, one of the most notable being 'Dickens Doctors' which he read before the Philologist Club, Philadelphia, May 28, 1903. It is regrettable that he did not include in the book an oration delivered in 1899 at the semicentennial exercises of the Philadelphia County Medical Society which was one of the most masterful products of his facile pen. Some of his other writings have been in collaboration with Dr. Frederick Packard on Keating's *Medical Dictionary* section on 'Metastasis', 'Dissection' for Nancrede's *Anatomy*, section on 'Epilepsy and Tetanus' in *First American System of Therapeutics* section on 'Diseases of the Testicle,' in Keating's *Cyclopedia of Children's Diseases* edited Zuckerkandl's *Operative Surgery* in 1899, first editor with Dr. Keen of Keen's *Surgery*, editor of *Anatomy*, the *Blood Alterations of Ether Anesthesia* in 1905 articles upon compound fractures of the skull amputation of hip joint, sarcoma of tonsil, treatment of skull blood changes in ether surgery of insanity surgery of epilepsy, and various literary topics.

His surgical teaching has permeated every civilized portion of the earth. He taught medical students from most countries, and visiting physicians and surgeons seldom missed an opportunity to attend his clinics. Rarely did his clinic which was not attended by some notable surgeon.

Dr Da Costa received his early surgical training under Dr Samuel W Gross. Before he became a medical student he used to attend the Saturday clinics at Blockley conducted by Dr Gross. Of him he said, "He made a most forcible impression upon my mind. His positive character his clean-cut sentences, his readiness to accept responsibility his scorn of clap-trap and hatred of boasting his diagnostic skill and operative ability, all captivated my youthful imagination. The same may well be said of Dr Da Costa.

He was intimately associated with Dr W W Keen, whose influence and daily contact did much to mold his surgical career. He succeeded Dr Keen upon his retirement in 1905 as professor of surgery in the Jefferson Medical College. Later his colleagues were Dr John H Gibbon and Dr Francis T Stewart, deceased, indeed a strong surgical team.

Dr Da Costa was married to Miss Mary Roberts Brick in 1894, member of a prominent Philadelphia family who survives him. There were no children.

He became ill with a form of arthritis more than a decade ago. Because of the painful and deforming arthritis, for approximately ten years he conducted his lectures and diagnostic clinics sitting in a wheel chair. He retained his keen mental process until a few days before his death, May 16 1933.

In the passing of Dr Da Costa the faculty of Jefferson has lost one of its ablest members the profession has lost a great teacher a resourceful surgeon a distinguished author Philadelphia has lost a valuable citizen and a man of forceful character.

EDWARD J KLOPF

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

A LARGE, well printed, thoroughly illustrated completely referenced treatise¹ on thyroid disease is presented by Joll in *Diseases of the Thyroid Gland*. The first half of the volume is devoted to the pathological anatomy and pathogenesis of goiter and thyroid dysfunction. The next quarter is given over to a discussion of thyrotoxicosis. In the last quarter, operative technique, anesthesia, post-operative care, complications, and results are clearly presented. The work is to be recommended for the detailed presentation of anatomy and pathology which will be useful for surgical study or for experimental approach. The discussion of thyrotoxicosis is in agreement with the best American opinion. The surgical technique is presented in useful form. The illustrations are excellent, they number 283 and there are 24 colored plates in addition. This volume of 682 pages fills the place of an authoritative reference work in one volume. It should be of great practical value.

PAUL STARK.

THE material in Kaiser's book² on tonsils has been gathered from a careful survey of 4,400 school children and covers a period of 10 years. Although operation was recommended in all cases only 50 per cent consented, the remaining half being used as controls. Three years after operation a survey was made and again 10 years after operation and a careful check was made to determine the incidence of the more common complaints of childhood. Statistics gathered bring to light many interesting facts. Apparent benefits during the first few years after operation are not so evident over a 10 year period. This is particularly true of acute head colds and otitis media where the incidence is about the same in tonsillectomized and non tonsillectomized children after a 10 year interval. Certain conditions are decidedly benefited by the removal of tonsils and adenoids such as acute sore throats and cervical adenitis. On the contrary, infections in the respiratory tract such as laryngitis, bronchitis and pneumonia seem to be adversely affected.

The book contains 300 pages and 27 chapters. Besides the statistical data there is much concerning the anatomy and physiology and bacteriology of the tonsils. The book offers a ready reference for

pediatricians and otolaryngologists and serves to clarify and remove uncertainties regarding the operation for tonsils and adenoids in childhood.

J. F. DELLE.

THE subject of electrosurgery is presented by Kelly in a manual of 305 pages with 382 illustrations.³ The various operations with electrodesiccation, electrocoagulation, and acusection,⁴ or cutting are described, as are the preparation of the patient, the anesthesia, and the postoperative care. The book is largely a regional operative surgery invaluable for any surgeon interested in perfecting himself in electrosurgical technique. The various types of current and their specific effects are discussed, but little is said of electrical theory in comprehensible to the average operating surgeon. It should be emphasized that this is not just another volume on the extirpation of malignancies, but rather a treatise on the technique of skin, oral, otolaryngological, thyroid, breast, abdominal, urological operations, etc.

This book is the authoritative work on operative electrosurgery at the present time.

JOHN D. ELLIS.

THE seventh volume of this stupendous third edition⁵ of Veit's *Handbuch der Gynaecologie* is in keeping with those volumes previously reviewed. It is encyclopedic in character devoting as it does, almost six hundred pages to diseases of the ovary and parovarium, and over four hundred pages to tumors of the uterine tubes.

The first section is written by Kermauner of Vienna and is probably one of the last of his writings as his death occurred some months ago. This section is carefully and completely written and illustrated. It takes up every type of ovarian disease and ovarian and parovarian tumor that has ever been described in the world literature. It is well illustrated and contains many color plates. This section of the book makes a perfect reference work on the subjects under consideration.

The second half of the book is devoted to tumors of the uterine tubes. This subject is one of interest

¹DISEASES OF THE THYROID GLAND WITH SPECIAL REFERENCE TO THYROIDISM. By Cecil A. Joll, M.S., B.Sc. (Lond.), F.R.C.S. (Eng.). St. Louis: The C. V. Mosby Company 1921.

²KAISER'S TONSILS IN OR OUT: A CRITICAL STUDY OF THE KNOWLEDGE OF TONSILLECTOMY. By Albert D. Kaiser, M.D. Philadelphia, London, Montreal: J. B. Lippincott Company 1922.

³ELECTROSURGERY. By Howard A. Kelly, M.D., LL.D., F.A.C.S., and Grant E. Ward, M.D., F.A.C.S. Philadelphia and London: W. B. Saunders Company 1922.

⁴VEIT'S HANDBUCH DER GYNAECOLOGIE. Edited by Dr. W. Stoedcker. Vol. VII.—Die Erkrankungen der Eierstöcke und Nebeneierstöcke und des Geschlechts der Eileiter. Edited by F. Kermauner and L. Naeuberger. Munich: J. F. Bergmann, 1922.

and must of course be included in any work dealing with gynecology. To devote over four hundred pages to this subject seems most unnecessary. This section is a complete résumé of all tumors of the uterine tubes reported to date which is desirable in an encyclopedic work of this type. Devoting two hundred pages to a tabulated analysis of the reports on primary carcinoma of the tubes seems to over shoot the purpose of this work. Nuernberger would have made his section much more readable and usable if he had reduced this section to approximately one-third or one-quarter of its present size.

RALPH A. REIN.

IT is very welcome to have the unsolved problem of idiopathic atelectases presented in monographic form.¹ The solution of the etiology of spure is especially fascinating since one feels that important physiological facts, hitherto unsuspected, must be brought to light with it. There is, of course, no such interest in this disease for those who consider spure as definitely caused by moulia or for

those who believe non tropical spure to be a rarity unrelated to tropical spure. But the writer demonstrates from the cases studied here that this disease when recognized is the result of marked physiological disturbances, i.e. a functional disorder of unknown gastro-intestinal mechanisms that minor grades of it are probably of frequent occurrence, and that tropical and non-tropical spure are the same disease. This monograph is careful and scientific photomicrographs of pathological material are included. The literature has been carefully studied and is reviewed constantly in connection with every aspect of the disease. PAUL STARR.

THE principles of elementary anatomy physiology massage and remedial gymnastics are embodied in concise form in the excellent textbook¹ for students of massage by Despard. The anatomic illustrations are excellent, and the directions for massage and therapeutic exercise are clear and concise. It can be recommended as a textbook for physical therapy technicians. J. S. COOLIDGE.

Non-Tropical Spure, *Spure in Infantile Strabismus*, By Th. E. Hoss Teyssie, M.D. Copenhagen: Levin & Munksgaard, London: Oxford University Press, 1933.

TEXT BOOK OF MASSAGE AND REMEDIAL GYMNASTICS, 4th ed. By L. Despard. London and New York: Hamsbury Mallord, Oxford University Press, 1932.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgement must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

NEUROLOGICAL EFFECTS OF SYPHILIS. DIAGNOSIS AND TREATMENT. By Bryan Buckley Sharp, M.D. M.R.C.P. (Lond.) London: Oxford University Press, 1933.

THE INTERNATIONAL MEDICAL ANNUAL. Editors: Carey F. Coombs, M.D. F.R.C.P. (the late) A. Readie Short, M.D. B.S. B.Sc., F.R.C.S. 1933, Fifty-First Year. Baltimore: William Wood and Co., 1933.

LYMPHATICS, LYMPHS AND THYROID FLUID. By Cecil K. Drinker, B.S. M.D., and Madeleine E. Field, A.B. Ph.D. Baltimore: The Williams & Wilkins Company, 1933.

SURGICAL PATHOLOGY. By William Boyd, M.D. M.R.C.P. (Ed.), F.R.C.P. (Lond.) etc. 3rd ed. Philadelphia and London: W. B. Saunders Company, 1933.

DIE BLUTERGIESSENUNG IM THEORIE UND PRAKIS. By Dr. Med. Hans Willebrand. Berlin: Julius Springer, 1933.

HOLT'S DISEASES OF INFANCY AND CHILDHOOD etc. Revised by L. Emmett Holt, Jr. M.D. and Rosalie McIntosh, M.D. 10th ed. New York and London: D. Appleton and Company, 1933.

INTERNAL DERANGEMENTS OF THE KNEE JOINT, etc. By A. G. Timbrell Fisher, M.C., M.B. Ch.B. F.R.C.S. (Eng.) 3rd ed. New York: The Macmillan Company, 1933.

ARTERIOVENOUS A SURVEY OF THE PROBLEM. (By various contributors.) A Publication of The Jewish Macy Jr. Foundation. Edited by Edmund V. Cowdry. New York: The Macmillan Company, 1933.

THE RHYTHM OF STERILITY AND FERTILITY IN WOMEN. By Leo J. Lutz, A.B., M.D. LL.D. 3d rev. ed. Chicago: Lutz Foundation, 1933.

MEDICAL STATE BOARD EXAMINATIONS. TOPICAL SUBJECTS AND ANSWERS, REVIEW OF ACTUAL QUESTIONS GIVEN, etc. By Harold Rypins, A.B. M.D. Philadelphia: J. B. Lippincott Co., 1933.

THE CYCLOPEDIA OF MEDICINE. George Morris Pictet, B.S., M.D., Editor-in-Chief. Charles E. de M. Sajous, M.D. LL.D. Sc.D. Founder and Firm Editor. Vols. 1-vol. Philadelphia: F. A. Davis Company, 1933.

ATLANTE DI CHIRURGIA DELLO STOMACO. By G. Egidi. Rome: Luigi Pozzi, 1933.

LE NYSTAGMUS VESTIBULAIRE ET LES RÉACTIONS DE MOUVEMENTS. By R. Clouet. Paris: M. Maloine, 1933.

NATURAL CHILDRENT. By Granty Dick Read, M.A. M.D. London: William Heinemann, Ltd., 1933.

SURGICAL ANATOMY. By C. Lathier Callander A.B. M.D. F.A.C.S. Philadelphia and London: W. B. Saunders Company, 1933.

MASSAGE AND REMEDIAL EXERCISES, IN MEDICAL AND SURGICAL CONDITIONS. By Noel M. Tidy. Baltimore: William Wood and Company, 1933.

DISEASES OF INFANCY AND CHILDHOOD. By Leonard G. Parnes, M.D., F.R.C.P. and Seymour Barling, C.M.G. F.R.C.S. New York, London: Oxford University Press, 1933.

THE WELLCOME RESEARCH INSTITUTION AND THE AFFILIATED RESEARCH LABORATORIES AND MUSEUMS. London: The Wellcome Foundation, Ltd., 1933.

A TEXT BOOK OF NEUROPATHOLOGY. By Arthur Weil, M.D. Philadelphia: Lea & Febiger, 1933.

SURGERY OF THE STOMACH AND DUODENUM. By J. Shelton Hensley, M.D. F.A.C.S. LL.D. St. Louis: The C. V. Mosby Company, 1933.

MODERN ASPECTS OF GASTRO-ENTEROLOGY. By M. A. Arns, M.R.C.P. (Lond.) Baltimore: William Wood and Company, 1933.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

J BENTLEY SQUIER, New York *President*

WILLIAM D HAGGARD Nashville, *President Elect*

FRANKLIN H. MARTIN, Chicago, *Director-General*

PHILIP H KREUSCHER, *Chairman* OSCAR E NADEAU, *Secretary, Committee on Arrangements*

PRELIMINARY PROGRAM FOR THE CLINICAL CONGRESS IN CHICAGO

THE surgeons of Chicago are keenly interested to present a program of clinics and demonstrations that will provide a complete showing of the clinical activities in all departments of surgery in this great medical center during the twenty third annual Clinical Congress of the American College of Surgeons, October 9-13. A preliminary schedule of operative clinics and demonstrations as prepared by the Committee on Arrangements, is presented in the following pages. It will be noted that clinics are scheduled to begin at 2 o'clock on the afternoon of Monday October 9 continuing through the four following days with sessions both morning and afternoon.

The Committee on Arrangements under whose supervision the clinical program is being prepared appointed by the Board of Regents of the College, is comprised of the members of an Executive Committee—Philip H. Kreuscher chairman Oscar E. Nadeau, secretary Joseph Beck William R. Cubbins, Frederick H. Falls, Harry S. Gradle, Carl A. Hedblom, Charles E. Kahlke, Herman L. Kretschmer Karl A. Meyer Dallas B. Phemister, Edwin W. Ryerson, and Henry Schmitz—together with representatives of each of the hospitals and medical schools appearing in the clinical program. In making its plans the Committee has been assured of the hearty co-operation of the clinicians of the medical schools and more than fifty hospitals that will participate in the clinical program.

Special features of the clinical program include (1) Cancer clinics demonstrating the treatment of cancer cases by surgery radium and X ray (2) fracture clinics in several hospitals where modern methods of the treatment of fractures will be demonstrated (3) traumatic surgery clinics demonstrating the newer methods of rehabilitation by surgery and physiotherapy of

patients injured in industrial, automobile and other accidents.

Other important features of the general program for the Congress include (1) Conference on fractures on Tuesday afternoon arranged by the College Committee on the Treatment of Fractures, (2) a symposium under the auspices of the Board on Industrial Medicine and Traumatic Surgery on Friday afternoon (3) a symposium on the teaching of surgery and the surgical specialties on Thursday afternoon following the annual meeting (4) a symposium on urological surgery on Friday morning the program for which appears on another page

Two sub-committees have been appointed to supervise the program for the sections on surgery of the eye ear nose and throat as follows Ophthalmology—Harry S. Gradle chairman Thomas D. Allen, E. K. Findlay Sanford Gifford Otolaryngology—Joseph Beck chairman Austin A. Hayden, Edward P. Norcross, S. J. Pearlman. The recommendations of these committees insure a worth while program of clinics and scientific sessions for all those interested in these specialties.

The College celebrates its twentieth anniversary at this session—the first convocation having been held in Chicago in 1913. The first Clinical Congress was held in this city in 1910, and it will be recalled that that session was attended by a large number of enthusiastic surgeons from all parts of the United States and Canada.

EVENING MEETINGS

The Central Executive Committee of the Congress is preparing programs for a series of five evening meetings which are to be held in the ballroom of the Stevens Hotel. A preliminary outline of these programs will be found on another page.

An interesting feature of the presidential meeting on Monday evening, in addition to the inauguration of new officers, will be the introduction of distinguished visiting surgeons from foreign countries, a large number of whom have been especially invited to attend the Congress this year. Among those who have indicated their intention of being present are Prof. Dr. Eugen Kisch, Graefenberg, Bohemia; Mr. Adams A. McConnell, Dublin, Ireland; Prof. Nissen, Berlin, Germany; Prof. Dr. Wolfgang Rosenthal, Leipzig, Germany; Prof. H. Beckwith Whitehouse, Birmingham, England.

Programs are being prepared for sessions on Tuesday and Thursday evenings at which papers and discussions will deal with subjects of special interest to ophthalmologists and otolaryngologists.

SYMPOSIUM: CANCER IS CURABLE

In this symposium, to be held in the ballroom of the Stevens Hotel on Wednesday afternoon at 3:30, a large number of eminent surgeons of wide experience in varied fields of surgical practice from all parts of the United States and Canada, will present their reports as to cases of cancer cured for a period of five years or longer. At the Congress in St. Louis last year a similar symposium established a new viewpoint for the profession and the laity creating widespread favorable comment.

Cancer as an Arrestable Disease. ROBERT H. GREENWOOD, M.D., Boston, Chairman, Committee on the Treatment of Malignant Diseases; FRANKLIN H. MARSH, M.D., Director-General, American College of Surgeons; CHARLES A. DICKER, M.D., Oakland, Calif. General Cases of Five Year Cures: IRVIN ASKILL, M.D., Louisville, Ky.; FRANK K. BOLAND, M.D., Atlanta, Ga.; JOHN JOSEPH GALLAGHER, M.D., Salt Lake City, Utah; CHARLES C. LUKO, M.D., Boston; JAMES MONROE MAROW, M.D., Birmingham, Ala.; JOHN T. MOORE, M.D., Houston; DAMON B. PREFFER, M.D., Philadelphia; EDWARD H. POOL, M.D., and J. A. VICTOR, M.D., New York.

Cancer of the Breast. MALVERN B. CLOUTON, M.D., St. Louis; E. STARR JORD, M.D., and S. W. HARRINGTON, M.D., Rochester, Minn.; RICHARD R. SMITH, M.D., Grand Rapids, Mich.

Cancer of the Pelvic Organs and Breast. BROOKER M. AMPACK, M.D., Philadelphia; HARRY S. CROMBIE, M.D., St. Louis; WILLIAM P. HEALY, M.D., New York.

Cancer of the Pelvic Organs. JAMES C. MARROW, M.D., Rochester, Minn.

Cancer of the Rectum. ROBERT C. CONVEY, M.D., Portland, Ore.

Cancer of the Thyroid Gland and Large Intestine. JOHN DEJ. PICKERERTON, M.D., and C. F. DIXON, M.D., Rochester, Minn.

Cancer of the Thyroid. MARTIN B. THURKE, M.D., Ithaca, N.Y.

Cancer of the Mouth, Tongue and Lips. WILLIAM H. O. LOGAN, M.D., Chicago.

Malignant Bone Tumors. WILLIAM B. COLBY, M.D., New York.
Cancer of the Throat, Esophagus and Bronchi. CHEVALIER JACKSON, M.D., Philadelphia.

ANNUAL HOSPITAL CONFERENCE

An interesting program of papers, round table conferences and practical demonstrations dealing with the many problems related to hospital efficiency is being prepared for the sixteenth annual hospital conference which opens at 10 o'clock on Monday morning in the ballroom of the Stevens Hotel, continuing on Tuesday Wednesday and Thursday. It is planned to give the program a broad interest with a careful selection of subjects to be discussed by eminent authorities in the surgical and hospital field. The papers will deal with many of the vital problems affecting administrative, professional and nursing phases of hospital work. Particular emphasis will be directed toward professional standards and the highly important problem of medical economics.

Morning sessions on Tuesday Wednesday and Thursday will be devoted to papers, discussions and round table conferences at the Stevens Hotel. An important and most interesting feature this year will be a series of demonstrations in several of the hospitals on Tuesday Wednesday and Thursday afternoons dealing with departmental organization, management and functions. These "clinics" in hospital administration will afford opportunities for the visitors to see how others do the things they are constantly doing in their own institutions, and in comparison appraise their own methods.

The greatly increased interest on the part of the surgeon in both the administrative and scientific phases of hospital work has been evidenced in recent years, and for this reason the program to be presented will be unique in providing a discussion of several subjects of importance to the three major groups working in the hospital—medical, nursing and business. An opportunity will be afforded to chiefs of staffs, heads of departments and members of medical staffs to participate in a program that deals particularly with the care of the patient, expecting to benefit by contact with and interchange of ideas with trustees, superintendents and others concerned with hospital administration.

HEADQUARTERS—HOTELS

General headquarters for the Clinical Congress will be established at the Stevens Hotel, located on Michigan Avenue between Seventh and Eighth Streets. This hotel affords unusual facilities for

all activities of the Congress, as will be remembered by those who attended the Congress in Chicago in 1929. The grand ballroom on the second floor with other large rooms on the third floor and the exhibition hall have been reserved for the exclusive use of the Congress. All of the evening sessions, the hospital conference on Monday, the annual meeting, the cancer and fracture symposium will be held in the grand ballroom. The registration and information bureau together with the bulletin boards on which will be displayed the daily clinical program will be established in the exhibition hall in the basement together with the Technical Exhibition.

Chicago has many fine, large hotels several within walking distance of the headquarters hotel. A list of the hotels recommended by the Committee on Arrangements is presented herewith. While Chicago's hotel facilities are very great and there should be no difficulty in securing first class hotel accommodations, it is advisable for those who expect to attend the Clinical Congress to reserve their hotel accommodations as far in advance as possible, as the Century of Progress Exposition will undoubtedly bring to Chicago a very large number of visitors.

The Technical Exhibition of the Clinical Congress will be located in the Exhibition Hall together with the registration and information bureau. In the same room will be found the bulletin boards on which the daily clinical programs will be posted each afternoon. The leading manufacturers of surgical instruments, X-ray apparatus, operating room lights, hospital apparatus and supplies of all kinds, ligatures, dressings, pharmaceuticals, and publishers of medical books will be represented in this exhibition.

We are assured that the railways of the United States and Canada will grant especially low rates on account of the Clinical Congress in connection with the Century of Progress Exposition in Chicago. Applications for reduced fares are pending before the railway traffic associations.

ADVANCE REGISTRATION

The hospitals of Chicago afford accommodations for a large number of visiting surgeons but

CHICAGO HOTELS AND THEIR RATES

| | Minimum Rates With Bath | |
|--|----------------------------|--------|
| | Single | Double |
| Ambassador, North State Street at Goethe | \$3 50 | \$6 00 |
| Auditorium, Michigan Blvd. and Congress | 3 50 | 6 00 |
| Belden Stratford, 2300 Lincoln Park West | 4 00 | 6 00 |
| Belmont, Sheridan Road at Belmont | 4 00 | 5 00 |
| Bismarck, Randolph at LaSalle St. | 3 50 | 5 00 |
| Blackstone, Michigan Blvd. and 7th St. | 3 00 | 5 00 |
| Brevort, 120 West Madison St. | 2 50 | 3 50 |
| Congress, Michigan Blvd. and Congress | 4 00 | 6 00 |
| Drake, Lake Shore Drive and Michigan | 3 00 | 5 00 |
| Edgewater Beach, 5300 Sheridan Road | 4 00 | 6 00 |
| Great Northern, Jackson and Dearborn | 2 50 | 4 00 |
| Knickerbocker, 163 East Walton | 3 00 | 5 00 |
| LaSalle, LaSalle at Madison St. | 2 50 | 4 00 |
| Morrison, 70 West Madison St. | 3 00 | 4 50 |
| Palmer House, State and Monroe Sts. | 3 50 | 6 00 |
| Pearson, 100 East Pearson St. | 3 00 | 5 00 |
| Stevens, Michigan Blvd. bet. 7th and 8th | 3 50 | 5 00 |

to insure against overcrowding the attendance will be limited to a number that can be comfortably accommodated at the clinics—the limit of attendance being based upon the results of a survey of the amphitheaters, operating rooms, and laboratories of the hospitals and medical schools to determine their capacity for visitors. It is expected therefore, that those surgeons who wish to attend the Clinical Congress in Chicago will register in advance.

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics and insures against overcrowding as the number of tickets issued for each clinic will be limited to the capacity of the room in which that clinic will be given.

A registration fee of \$5 00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card which is non-transferable must be presented in order to secure clinic tickets and admission to the evening meetings.

PRELIMINARY PROGRAM FOR EVENING MEETINGS

IN THE BALLROOM OF THE STEVENS HOTEL AT 8 15

Presidential Meeting Monday October 9

Address of Welcome. PHILIP H. KREUSCHER, M.D. Chairman of Committee on Arrangements
 Introduction of Foreign Guests. FRANKLIN H. MARTIN M.D., Director-General
 Address of Retiring President. J. BENTLEY SQUIER, M.D. New York
 Inauguration of Officers
 Inaugural Address. WILLIAM D. HAGGARD M.D. Nashville, Tenn.
 John B. Murphy Oration in Surgery. LOYAL DAVIS, M.D., Chicago

Tuesday Wednesday and Thursday October 10 11 and 12

Symposium on Vascular Diseases

Thrombo-Angiitis Obliterans (Buerger's Disease) GEORGE E. BROWN M.D., Rochester Minn.
 Ligation of Large Arteries. MORT ROOKES REID M.D. Cincinnati

Symposium on Diseases of the Thyroid

Hyperthyroidism and Associated Diseases. GEORGE W. CRILE, M.D. Cleveland
 The Treatment of Exophthalmos. HOWARD C. NATHAN, M.D. San Francisco
 Tumors of the Parathyroid Glands. EDWARD D. CHURCHILL, M.D., Boston

The Common Syndrome of Rupture, Dislocation and Elongation of the Biceps Brachii an Analysis of Over Forty Cases. EDGAR L. GILCREST M.D. San Francisco

Sympathectomy in Children. DAVID EDWIN ROBERTSON M.D., Toronto

Convocation—Friday October 13

Invocation

Conferring of Fellowships

Conferring of Honorary Fellowships

Presidential Address. WILLIAM D. HAGGARD M.D., Nashville, Tenn.

Fellowship Address. ROBERT MAYNARD HUTCHINS, A.M., LL.D. President, University of Chicago

SYMPOSIUM ON UROLOGICAL SURGERY

BALLROOM, STEVENS HOTEL, FRIDAY 11 A.M.

JOHN R. CAULK, M.D. St. Louis Transurethral Surgery

FRANK HODMAN M.D. San Francisco: The Pathogenesis of Hydronephrosis.

JOSEPH F. MCCARTHY M.D. New York The Prostate Gland—Its Place in General Medicine Newer Conception of Diagnosis and Therapy

PRELIMINARY CLINICAL PROGRAM

GENERAL SURGERY, GYNECOLOGY, OBSTETRICS, ORTHOPEDICS, UROLOGY, PROCTOLOGY, SURGICAL PATHOLOGY, ETC.

PASSAVANT MEMORIAL HOSPITAL—NORTH
WESTERN UNIVERSITY MEDICAL SCHOOL

Tuesday

- LEANDER W. RIBA—9. The use of the electro-urethrotome in urethral strictures.
ARTHUR H. CURTIS and GEORGE H. GARDNER—9. Gynecological operations.
JOHN A. WOLFER—9. Cholecystitis, carcinoma of colon.
JACOB R. BUCHBINDER—9. Thyroid surgery
JOHN S. COULTER—10. Physical therapy
RUDOLPH W. HOLMES and staff—2. Symposium on cardiac diseases in their obstetric associations. CHAURCEY C. MARKER. Etiology and pathology. JAMES E. FITZGERALD. Medical aspects and treatment. JAMES H. BLOOMFIELD. Obstetrical aspects and treatment.
PAUL B. MAGNUSON—2. Ununited fracture of the neck of the femur. Bone graft in the spine.
JOHN A. WOLFER—2. Dry clinic. Alimentation of the critically ill patient by jejunal feedings.
LOYAL DAVIS, LEWIS J. POLLOCK, HALE HAYES and DAVID A. CLEVELAND—2. Symposium on neurologic surgery

Wednesday

- HARRY M. RICHTER—9. Thyroid surgery
LOYAL DAVIS—9. Neurologic surgery
SUMNER L. KOCH and MICHAEL L. MASON—9. Nerve and tendon surgery of the hand.
JAMES T. CASE—10. Roentgenology
PHILIP H. KREUSCHER—2. Hip joint surgery
ALLEN B. KAWAYEL, SUMNER L. KOCH and M. L. MASON—2. Review of twenty years of surgery of the hand.
RUDOLPH W. HOLMES and staff—2. Symposium on toxemias of late pregnancy renal and hepatic. JAMES P. SMITH. Etiology and pathology. CHESTER C. DOWERY. Symptoms and laboratory investigation. DAVID S. HILLIS. Medical (expectant) treatment. RUDOLPH W. HOLMES. Obstetrical treatment.
LEANDER W. RIBA—2. Dry clinic. Prostatic resection.
EMIL D. W. HAUSER—2. Orthopedic surgery

Thursday

- ARTHUR H. CURTIS and GEORGE H. GARDNER—9. Gynecological operations.
JOHN A. WOLFER—9. Cholecystitis carcinoma of the breast.
JACOB R. BUCHBINDER—9. Abdominal surgery
JOHN S. COULTER—10. Physical therapy
PHILIP H. KREUSCHER—2. Shoulder and knee joint disengagement.
RUDOLPH W. HOLMES and staff—2. Symposium on obstetrical hemorrhages. RUDOLPH W. HOLMES. Abatto placentae. DAVID S. HILLIS. Placenta previa. MAGNUS P. URMER. Postpartum hemorrhages. THEODORE W. BLUTCHER. Treatment of sequential anemias.
CHARLES A. ELLIOTT, WALTER H. NADLER, PAUL STARR, M. HERBERT BARKER, HOWARD B. CARROLL and HOWARD L. ALT—2. Symposium on hepatic disease.

Friday

- HARRY M. RICHTER—9. Gastric surgery
LOYAL DAVIS—9. Neurologic surgery
SUMNER L. KOCH and MICHAEL L. MASON—9. Irradiation ulcers of the hand, Dupuytren's contracture.

- JAMES T. CASE—10. Roentgenology
PAUL B. MAGNUSON—2. Demonstration of principles for overcoming deformity in ununited fractures before operation. Bone grafts for ununited fractures.
RUDOLPH W. HOLMES and staff—2. Symposium on hyperemesis gravidarum. CHESTER C. DOWERY. Etiology and pathology. MAGNUS P. URMER. Symptoms and clinical course. JAMES H. BLOOMFIELD. Treatment.
HARRY M. RICHTER, ANDREW C. IVY, SAMUEL J. FOGELSON and A. J. ATKINSON—2. Symposium on gastric ulcer

MOUNT SINAI HOSPITAL

Tuesday

- V. L. SCHRAGER and associates—9. Hernia breast and biliary surgery
ISRAEL DAVIDSON—11. Pathological demonstration.
M. I. KAPLAN—11. X ray diagnosis and therapy
GUSTAV KOLNICKER and HARRY ROLNICK—2. Genito-urinary surgery

Wednesday

- HARRY M. RICHTER and associates—9. Gastric and thyroid surgery
ISRAEL DAVIDSON—11. Pathological demonstration.
M. I. KAPLAN—11. X ray diagnosis and therapy
ALFRED A. STRAUSS—2. Gastro-intestinal surgery
RALPH B. BETTMAN and associates—2. Intrathoracic surgery operations.

Thursday

- AARON KANTER, A. F. LASH and associates—9. Gynecological operations.
ISRAEL DAVIDSON—11. Pathological demonstration.
M. I. KAPLAN—11. X ray diagnosis and therapy
CHARLES JACOBS and associates—2. Orthopedic operations.

Friday

- HARRY ROLNICK—9. Genito-urinary surgery
ISRAEL DAVIDSON—11. Pathological demonstration.
M. I. KAPLAN—11. X ray diagnosis and therapy

Dry Clinics—Daily 9 and 2

- ISRAEL DAVIDSON. Value of biopsy in surgery
HENRY BOXBAUM. Toxemias of pregnancy
GUSTAV KOLNICKER. Electrosurgery in cancer therapy
AARON KANTER. Chorio-epithelioma following a vesicular mole: functional uterine hemorrhage.
HARRY ROLNICK. Bladder tumors.
A. F. LASH. Treatment of birth injury—early diagnosis of uterine cancer
DAVID A. WILLIS. Relation of adrenals to thyrotoxicosis morbidity in operation for acute appendicitis in relation to the question of drainage demonstration of a universal traction splint as used in a small hospital.
EMIL L. ARNOV. Fractures of the maxilla and mandible.
M. REESE GUTTMAN. Recent advances in the treatment of malignant diseases about the head and neck—endoscopic clinic.
Staff. Symposium. Cancer of the lung. I. M. TRACE, medical aspect. JACOB LITSCHUTZ, bronchoscopic aspect. ISRAEL DAVIDSON, pathological aspect. M. I. KAPLAN. X ray aspect.
MAURICE LEWISON. Medical appraisal of surgical risks.

PRESBYTERIAN HOSPITAL

Tuesday

- A. D. BEVAN—9. Surgery of the breast
 V. C. DAVID—9. Carcinoma of sigmoid.
 H. L. KRETSCHMER—9. Kidney surgery
 R. H. HERBERT—9. Transurethral electro resection of prostate gland.
 KILLGUS SWEED—9. Tumors of chest wall, demonstration of cases, lantern slides
 A. H. MONTGOMERY—1. Abdominal surgery in children
 A. VIKERSVOGHEM—1. Neurosurgical operation

Wednesday

- A. D. BEVAN—9. Hemia and undescended testicle
 F. B. MOOREHEAD—9. Plastic surgery of mouth and face
 C. B. DAVID—9. Tumors of the large intestine.
 H. L. KRETSCHMER—9. Surgery of the bladder
 N. S. HURLEY—9. Vaginal surgery
 DR. GATEWOOD—10. Carcinoma of the stomach, follow-up clinic
 E. M. MILLER—10. Thyroid surgery
 H. A. OVERHELMAN—10. Surgery in diabetic patients.
 E. R. MCCARTHY—1. Strangulated hernia in infants
 W. J. POTTS—11. Fracture problems

Thursday

- A. D. BEVAN—9. Surgery of gall bladder and bile tract.
 H. L. KRETSCHMER—9. Transurethral resection of the prostate.
 F. B. MOOREHEAD—9. Cleft palate surgery; operative treatment of ankylosis of jaw
 DR. GATEWOOD—9. Gastric resection for ulcer
 R. H. HERBERT—9. Diverticula of urinary bladder
 R. H. HERBERT and C. W. APPENZELER—9. Unusual urinary anastomoses.
 Staff—9. Dry clinic E. D. ALLER endometriosis C. P. BAUER, dystocia ALAN KAMET, recognition of early carcinoma of uterus.
 G. L. McWHORTER—10. Fracture of the greater tuberosity of the humerus
 A. VIKERSVOGHEM—11. Spinal cord injuries

Friday

- Staff—9. Dry clinic A. D. BEVAN Present status of anesthesia. H. L. KRETSCHMER. Genito-urinary surgery R. C. BROWN Treatment of massive hemorrhage in gastric ulcer. V. C. D. VIB. Significance of polyps of large bowel. F. M. MILLER Method of intravenous injection over long period of time. R. H. HERBERT Fibrosis of bladder neck. P. H. STRAUSS Obstructive jaundice. G. L. McWHORTER Reconstruction of common bile duct, cases. M. L. LORING. Granuloma inguinale, cases. S. E. LAWTON. Cholecystenterostomy Indications
 E. J. REISCHNER—1. Orthopedic clinic.

WASHINGTON BOULEVARD HOSPITAL

Tuesday

- PATT. C. FOX—9. Gynecological clinic.

Wednesday

- A. R. MITZ—9. General surgical clinic, presentation of unusual fractures

Thursday

- V. J. O'CONNOR—9. Hydrocele, etiology and treatment, case reports, X-rays and operative results; suprapubic prostatectomy and transurethral resection of prostate comparatively indications and results.

ST. LUKE'S HOSPITAL

Monday

- H. E. MOCK, A. REID MONTGOMERY and CHARLES SHAWMONT—2. General surgical operations.
 E. OLSEN—2. Neurological surgery

Tuesday

- H. O. JONES, WILLIAM P. CARBELL, M. J. KILLY, E. A. EDWARDS and JOHN BREWER—9. Gynecological operations early human embryo, demonstration.
 CARL HEDGECOCK and WILLARD VAN HAZEL—9. Thoracic surgery
 H. E. MOCK—1. Reconstructive surgery
 L. L. McARTHUR and S. W. McARTHUR—1. General surgery

Wednesday

- L. E. SCHMUT—9. Urological clinic
 E. W. RYERSON and F. A. CHAMBLER—9. Orthopedic operations.
 S. C. PLUMMER—9. General surgery
 H. E. JONES and T. L. HARRIS—9. General surgery
 E. W. RYERSON, R. O. RITTER and H. Q. SOTFIELD—1. Orthopedic operations
 FRANK E. DAVID, C. J. DEBERE and G. V. PONTIUS—1. Rectal surgery

Thursday

- G. DE TAKATS—9. Surgery in juvenile diabetes, ambulatory with ligation of venous veins.
 H. E. MOCK—9. General surgery
 HARRY CULVER—9. Urological clinic
 H. E. MOCK, A. REID MONTGOMERY and CHARLES SHAWMONT—2. Skull fractures.
 W. R. CURRIE—1. General surgery
 H. B. THOMAS and F. W. HARR—1. Orthopedic clinic.

Friday

- W. F. LYON—9. Dislocations of the shoulder with fracture of the greater trochanter
 H. POTTS and F. W. McBRIDE—9. Oral surgery operative
 E. W. RYERSON, F. A. CHAMBLER and R. O. RITTER—1. Orthopedic clinic

SOUTH SHORE HOSPITAL

Tuesday

- AXEL WENCKELUS—9. Gastric surgery
 GEORGE G. O'BRYEN—11. General surgery
 CLARENCE S. DOWNS and AXEL WENCKELUS—1. Symposium on gastric and duodenal ulcer

Wednesday

- HUGH MACKENZIE—9. Surgery of the colon.
 FRANK G. MURPHY—11. Orthopedic clinic
 H. WILLIAM EICHENACKER, GUY S. VAN ALSTYCK and PAUL R. CARWY—1. Symposium on intramucosal

Thursday

- LOUIS D. SMITH—9. Genito-urinary surgery
 CLARA JACOBSON—1. Lung collapse procedures.
 C. C. MARRIS—3. Cardiac risk in surgery

Friday

- E. A. LUTTON—9. Gynecological clinic.
 ANDREW DANKLEBER and WILLIAM HARRIS—11. Operative obstetrics.
 H. R. CULVER—1. Industrial surgery
 WALTER FISCHER—1. Foot problems.

COOK COUNTY HOSPITAL

Monday

SUMNER L. KOCH—2 General surgery
F. H. FALLS—2 Gynecology
E. J. BERKEHEIMER—2 Orthopedics
WILLIAM R. CUBBINS—2 General surgery
M. DAVISON—2 General surgery

Tuesday

SUMNER L. KOCH—9. Diagnostic clinic
AARON KANTER—9. General surgery
GEORGE DAVIS—9. General surgery
A. H. MONTGOMERY—9. General surgery
A. H. CONLEY—9. Orthopedics
CAREY CULBERTSON—9. Gynecology
J. O'DONOGHUE—9. General surgery
HARRY CULVER—9. Urology
H. JACKSON—9. General surgery
MARCUS HOBART—9. Orthopedics
VERNON C. DAVID—9. Diagnostic clinic
L. C. GATEWOOD—9. General surgery
J. P. GREENHILL—2 Gynecology
RALPH B. BETTMAN—2 Surgery in tuberculosis
E. WARSZEWICKI—2 General surgery

Wednesday

CHAMKING BARRETT—9. Gynecology
HARRY CULVER—9. General surgery
V. L. SCHRAGER—9. General surgery
GEORGE APFELBACH—9. General surgery
J. G. FROST—9. General surgery
R. C. SULLIVAN—9. General surgery
L. L. VESSEY—9. Urology
FRANK JIRKA—9. General surgery
R. VAUGHAN—9. General surgery
PHILIP H. KREUSCHER—9. Orthopedics
CHARLES M. MCKENNA—9. Urology
H. ROBINCK—2. Urology
HARRY CULVER—2. Urology
GEORGE DAVIS—2. General surgery
J. R. BUCHENBINDER—2. General surgery
DAVID HILLIS—2. Obstetrical operations
SUMNER L. KOCH—2. General surgery

Thursday

PHILIP H. KREUSCHER—9. Orthopedics
CHAMKING BARRETT—9. General surgery
GEORGE DAVIS—9. General surgery
R. W. McNEALY—9. General surgery
MARCUS HOBART—9. Orthopedics
D. HORNST—9. Gynecology
KARL A. MEYER—9. General surgery
E. W. FISCHMAN—9. Gynecology
A. H. MONTGOMERY—9. General surgery
MAX THORCK—9. General surgery
A. H. CONLEY—9. Orthopedics
D. H. LEVINTHAL—9. Orthopedics
JOHN HARGRE—2. General surgery
F. H. FALLS—2. Gynecology
E. J. BERKEHEIMER—2. Orthopedics
RALPH BETTMAN—2. General thoracic surgery
WILLIAM R. CUBBINS—2. General surgery

Friday

GEORGE APFELBACH—9. General surgery
AARON KANTER—9. General surgery
R. C. SULLIVAN—9. General surgery
CAREY CULBERTSON—9. Gynecology
VERNON C. DAVID—9. General surgery
MARCUS HOBART—9. Orthopedics

F. G. DYAS—9. General surgery
J. O'DONOGHUE—9. General surgery
H. JACKSON—9. General surgery
L. C. GATEWOOD—9. General surgery
JOHN HARGRE—2. General surgery
J. R. BUCHENBINDER—2. General surgery
MARSHALL DAVISON—2. General surgery
E. WARSZEWICKI—2. General surgery
SUMNER L. KOCH—2. General surgery

MERCY HOSPITAL

Tuesday

E. M. BROWN—9. Malignancy of the colon.
J. E. KELLY—9. Chronic intestinal fistula extensive ventral hernia.
GEORGE GRIFFIN—9. Pyloric obstruction.
J. D. CLARIDGE—9. Fractures and dislocations of the cervical spine.
C. J. LARKIN—9. Rupture of the spleen simulating acute appendicitis.

Wednesday

M. F. McGUIRE—9. Biliary tract surgery
C. F. SAWYER—9. Acute pancreatitis, perforating gastric and duodenal ulcers.
C. L. MARTIN—9. Anal fistulectomies in cases with pulmonary tuberculosis.
L. E. GARRISON—9. Carcinoma of the colon carcinoma of the breast.
HERBERT E. LANDIS—9. Surgical anatomy of vesical orifice and urethral obstructions treatment of bladder tumors.

Thursday

L. D. MOOREHEAD—9. Toxic goiters differential diagnosis of cases of dythyroidism and hyperthyroidism with indication for operation and management.
W. J. PICKETT—9. Technical considerations in posterior gastro-enterostomy
F. E. PIERCE—9. Fracture cases.
F. M. DRENNAN and F. C. VALDEZ—9. Gastro-intestinal clinic.

Friday

HENRY SCHMITZ and HERBERT E. SCHMITZ—9. Gynecological clinic surgery and radiation therapy
JOSEPH LAINE—9. Carcinoma of the genito-urinary tract.
A. M. VAUGHN—9. Cystic hygroma in an infant.

CHILDREN'S MEMORIAL HOSPITAL

Monday

FREMONT A. CHANDLER, CHARLES N. PEASE and FERDINAND SEIDLER—2. Orthopedic clinic.

Tuesday

FREMONT A. CHANDLER, FERDINAND SEIDLER and CHARLES N. PEASE—9. Orthopedic operations.
FREDERICK B. MOOREHEAD—2. Oral surgery operations and demonstration of cases.

Wednesday

ALBERT H. MONTGOMERY and staff—9. General surgery operations and demonstration of cases.

Thursday

HERMAN L. KRETSCHMER and staff—9. Urological surgery operations and demonstration of cases.

Friday

ALBERT H. MONTGOMERY and staff—9. General surgery operations and demonstration of cases.

MICHAEL REESE HOSPITAL

Tuesday

ALFRED A. STRAUSS, SIGMUND F. STRAUSS, JAMES PATRICK and ROBERT A. CRAWFORD. Stomach resections for gastric and duodenal ulcer; common duct duodenal anastomosis and gastro-enterostomy for chronic obstructive jaundice.

GEORGE L. DAVENPORT and RALPH BETTMAN. Gall-bladder surgery—surgery of the common duct.

D. C. STRAUSS. Thyroid surgery.

E. FRANK. General surgery—surgery of the gall bladder.

BERNARD PORTIS. Thyroid surgery—surgery of the rectum.

HARRY RUCHTER. Thyroid surgery—gall-bladder surgery.

MAX CUTLER. Surgery of the breast.

GUSTAV KOLCHER. Diathermy of bladder tumor—saphrorectomy for tuberculous.

IRVING KOLL. Electrical resection of prostate—nephro-ethotomy.

DANIEL H. LEVINTHAL. Internal derangements of the knee joint, removal of semi-hunar cartilage—synovectomy for chronic arthritis, bone lengthening operation.

JULIUS E. LACKNER. Abdominal hysterectomy—interposition operation—rectovaginal fistula.

JOSEPH L. BAER and RALPH REIS. Complete perineal laceration, ovarian tumor and pelvic inflammation.

Wednesday

D. C. STRAUSS. Thyroid surgery—gall-bladder surgery.

RALPH BETTMAN. Surgery of the chest.

GEORGE L. DAVENPORT. General surgery.

ALFRED A. STRAUSS, SIGMUND F. STRAUSS and ROBERT A. CRAWFORD. Sectional colectomy for ulcerative colitis and pylosphincter for congenital pyloric stenosis.

BERNARD PORTIS. General surgery and surgery of the colon.

MORRIS L. PARKER. General surgery.

JAMES PATRICK. General surgery.

JOSEPH LEONHART. Undescended testis, suprapubic prostatectomy.

HARRY RUCHTER. Electric resection of prostate—pyelotomy for stones.

PHILIP LAWLER and SIDNEY SIDEMAN. Orthopedic clinic, shoulder elbow hand, hip pelvis.

L. E. FRANKENTHAL, SR. and L. E. FRANKENTHAL, JR. Gynecological operations.

W. H. REDOVITS. Obstetrical and gynecological clinic, demonstration of forceps, version and complete miter, episiotomy.

IRVING STEIN and M. L. LEVINTHAL. Obstetrical clinic, low cervical cesarean under local anesthesia.

Thursday

RALPH BETTMAN. Surgery of the gall bladder and common duct.

ALFRED A. STRAUSS, SIGMUND F. STRAUSS and ROBERT A. CRAWFORD. Sigmoid colectomy for carcinoma of the rectum—resections for carcinoma of the stomach.

D. C. STRAUSS. Surgery of the colon, small intestine and thyroid.

GEORGE L. DAVENPORT. Surgery of the common duct.

BERNARD PORTIS. General surgery.

SIGMUND F. STRAUSS. General surgery.

HARRY RUCHTER. Surgery of the thyroid.

E. FRANK. Surgery of the gall bladder and common duct.

ALFRED L. JONES. Nephrectomy for tuberculous kidney, suprapubic prostatectomy.

IRVING STRAUSS. Diathermy of bladder tumor—nephrectomy for tumor of kidney.

DANIEL H. LEVINTHAL. Surgery of the spine—fusion operation for scoliosis and for tuberculosis.

CHARLES M. JACOB. Orthopedic clinic.

JULIUS E. LACKNER. Gynecological operations.

JOSEPH L. BAER and RALPH REIS. Prolapsed vaginal hysterectomy—fibroids—occipt posterior.

Friday

ALFRED A. STRAUSS, SIGMUND F. STRAUSS, JAMES PATRICK and ROBERT A. CRAWFORD. Subtotal gastrectomy for gastroduodenal ulcer—resection of colon for carcinoma.

D. C. STRAUSS. Surgery of the thyroid and general surgery.

GEORGE L. DAVENPORT and RALPH BETTMAN. Gall-bladder surgery and surgery of the common duct.

RALPH BETTMAN. Thoracic surgery.

BERNARD PORTIS. Surgery of the colon and rectum.

MORRIS L. PARKER. General surgery.

MAX CUTLER. Surgery of the breast—use of radiotherapy in carcinoma.

FREDERICK LIEBERTHAL. Suprapubic prostatectomy—ureterotomy.

J. S. GROVE. Undescended testes.

PHILIP LAWLER and SIDNEY SIDEMAN. Orthopedic clinic, back, hip, knee, foot, shoulder—demonstration of arthritis cases.

L. E. FRANKENTHAL, SR. and L. E. FRANKENTHAL, JR. Gynecological clinic.

W. H. REDOVITS. Gynecological clinic.

IRVING STEIN and M. L. LEVINTHAL. Gynecological clinic.

RAVENSWOOD HOSPITAL

Tuesday

G. W. GREEN—9. Gall-bladder surgery—mortality and morbidity.

C. A. BOWWELL—9.30. Survey of cancer study organization in a private hospital.

D. B. POWELL—10. Orthopedic surgery.

E. W. MULLER and J. J. MOORE—10.30. Carcinoma of testis.

M. FIELD—1. Diagnosis and management of sterility.

L. C. FRENCH and D. L. JENKINSON—11.30. Gastric aphasia.

Wednesday

G. DE TARNOWSKY and J. J. MOORE—9. Carcinoma of colon, modified Kraske operation.

J. IRELAND—9.30. Fractures of the elbow.

R. F. WENDELANDER—10. Emotions as etiological factors in hyperthyroidism.

C. H. LOCKWOOD—10.5. Headaches.

H. P. SACKS—11. Blood transfusion.

L. E. DAY—11.5. Obstetrics.

J. F. OATES—1.30. Spinal anesthesia.

Thursday

C. C. RICHTER—9. Obstetrical anesthesia.

W. F. GOSWICK—9.15. Cesarean section.

A. C. HAMMETT—9.30. Mental disturbances of diabetes.

A. V. BENOQUET—9.45. Indigestion.

F. N. BURNETT—10. Granulosa cell carcinoma of ovary.

R. L. DYER—10.30. Surgical technique.

P. J. SARMA—11. Paramedian abdominal incision.

F. R. von NAWROCK—11.15. Mortality in appendicitis.

E. B. WILLIAMS—1.30. Pelvic disease—fracture of spine.

EVANGELICAL HOSPITAL

G. ELMAN JOHNSON. Clinical studies of extra-uterine pregnancy.

FRED E. HOPKINS. Clinical studies of procoarthritis.

CHARLES PARK. Treatment of lower limb fractures by fixed traction.

PAUL GEORGE PANDORF. Demonstration of models and photographs showing newer methods of the handling of fractures of the mandible and maxilla.

ST MARY OF NAZARETH HOSPITAL

Monday

- A. S. SAMPOLSKI—2. General surgical clinic.
E. H. WARASZEWski and P. F. CRWALDOWSKI—1. Inguinal hernia clinic.
THAD LARKOWSKI—2. Demonstration of blood transfusion.

Tuesday

- GEORGE MUELLER—9. General surgical clinic.
S. R. PIETROWICZ—9. Spinal puncture and anesthesia—indications, contra indications, advantages, disadvantages, demonstrations.
C. C. BUCZYNSKI—2. Varicocele operations and demonstrations.
M. J. BADZIEWICZ and B. PIETROWICZ—2. Goiter clinic, operations and demonstration of cases.

Wednesday

- T. Z. ZELOWSKI—9. Gynecology and abdominal surgery
W. A. KUTLEWSKI—9. Emergency and general surgery
THOMAS PLANT—9. General surgery
A. A. THEDA—9. General surgery
FRANK TENZAR—9. General surgery
JOHN TENZAR—9. General surgery
CHESTER CHALLENGER—9. X ray demonstration.
MICHAEL KUTZA—2. General surgery
F. A. MACKOWIAK—2. General surgery
M. E. UDAMSKI—2. Obstetrical clinic, low cesarean section.
M. KRUPINSKI—2. Removal of pilonidal cyst.

Thursday

- LEO CZAJA—9. Orthopedic clinic: maggot treatment of osteomyelitis.
E. MACDONALD—9. Abdominal surgery
H. H. HILL—9. Demonstration of pathological specimens.
A. V. PARTIPILO—2. Aseptic resection of the bowel, demonstration of cases, moving picture exhibition.
M. E. UDAMSKI—2. Surgical anatomy of the perineum, lantern slide demonstration.

Friday

- JOSEPH WELFELD—9. Urological clinic.
GEORGE MUELLER—9. General surgery
CHESTER CHALLENGER—9. X ray demonstration.
H. H. HILL—9. Demonstration of pathological specimens.
ROBERT E. FLANNERY—2. Gall-bladder surgery
LEO P. KOSZKOWICZ—2. Cesarean section indications, contra-indications, demonstrations.

WESLEY MEMORIAL HOSPITAL

Monday

- P. B. MACNUSON—2. Bone surgery

Tuesday

- R. W. MCNEALY—9. Gall bladder surgery: gastro-intestinal surgery
C. B. REED—2. Obstetrical clinic, moving picture demonstration of breech delivery, perineorrhaphy and for cephs delivery: demonstration of external measurements of intra uterine child.

Wednesday

- PETER H. KREUTSCHER—9. Joint surgery
GUY VAN ALSTYNE—9. Osteitis tuberculosa multiplex cystica (Jungling)

Thursday

- G. H. GARDNER and M. T. GOLDSTEIN—9. Gynecological clinic vaginal plastic work.

WOMEN AND CHILDREN'S HOSPITAL

Monday

- FRANCES FORD—2. X ray therapy in malignancies.

Tuesday

- BERTHA VAN HOOSSEN—9. General surgical operations.
JOSEPHINE MCCOLLUM and BERTHA VAN HOOSSEN—10. Demonstrations of morphine and scopolamine anesthesia in surgery
O. ZALKOWSKI—11. Demonstrations of electrocoagulation therapy

Wednesday

- PEARLE STETTLER—9. General surgical operations.
WALBURGA KACIN and CLARA OCHS—2. Obstetrical cases, management under scopolamine anesthesia.
FRANCES FORD—2. X ray demonstrations.
PEARLE STETTLER—2. Surgical diagnosis of appendicitis in children.

Thursday

- ALICE CONKLEN—9. General surgery
Staff—9. Fracture cases.
MARIE ORTMAYER—10. Urological clinic.
ANGELA GERVOTAS—11. Carcinoma of the pelvis.
ELOISE PARSONS—2. Endocrine therapy in gynecology sterility operations.

Friday

- MARY E. WILLIAMS—9. Gynecological operations.
CONSTANCE O'BREIN—11. General surgical operations.
MARY SPIVACK and FLORENCE HARK—2. Obstetrics.
CHARLES FORD—2. X ray and diathermy therapy

AUGUSTANA HOSPITAL

Tuesday

- N. M. PERCY and O. E. NADEAU—9. Goiter and general surgical clinic.

Wednesday

- A. T. LUNDGREN and EARL GARRIDE—9. General surgery
J. W. NUTUM—9. General surgical clinic.
R. J. ODEN—9. General surgical clinic.

Thursday

- N. M. PERCY and O. E. NADEAU—9. Goiter and general surgical clinic.

Friday

- A. T. LUNDGREN and EARL GARRIDE—9. General surgery
J. W. NUTUM—9. General surgical clinic.
R. J. ODEN—9. General surgical clinic.

GARFIELD PARK HOSPITAL

Tuesday

- JOHN R. HARGER and SAM PLICE—9. Surgery of the stomach, treatment of peptic ulcer
L. F. MACDIARMID—9. General surgery

Wednesday

- CLAUDE WELBY and JOHN H. FLOCK—9. Abdominal surgery

Thursday

- J. M. BERGER and FRANK CHAUVEY—9. General surgery

Friday

- CLARENCE SAKLITOFF—9. Dipilasic strains of bacteria from renal lesions, experimental production of lesions with spiroplasma (spirocheta pallida)
VALENTIN J. O'CONNOR—9. Tuberculosis of kidney with review of cases: hydronephrosis, plastic repair of nephropexy

COLUMBUS HOSPITAL

Tuesday

- DANIEL A. ORTE, C. O. LINTHROCK and M. L. HANMAN
—*g.* General surgery
DANIEL A. ORTE—*g.* Indications and contra-indications
for spinal anesthesia.
CHANDLING BARRITT—*g.* Gynecological operations.
MICHAEL JOHNSON—*g.* Collapse therapy in pulmonary
tuberculosis.
M. J. SEIFERT—*10.* Surgical treatment of ulcer of the
stomach.
MICHAEL JOHNSON—*2.* Surgery of the chest

Wednesday

- CHANDLING BARRITT—*g.* Gynecological clinic
G. N. BECKER and M. B. BURKE—*g.* Emergency surgery
in industrial injuries

Thursday

- MICHAEL JOHNSON—*g.* Surgical treatment of abscess of
lung
F. MUELLER and F. MUELLER, JR.—*g.* Transplantation of
bone.
WILLIAM GISEL and T. L. CROOKWORTH—*g.* Urological
clinic.
G. N. BECKER and M. B. BURKE—*g.* Emergency surgery
in industrial injuries

Friday

- DANIEL A. ORTE, C. O. LINTHROCK and M. L. HANMAN
—*g.* General surgery
M. J. SEIFERT—*g.* General surgery

HOSPITAL OF ST ANTHONY DE PADUA

Monday

- THOMAS DWYER—*2.* Demonstrations in surgical pathology

Tuesday

- LAWRENCE RYAN—*g.* General surgery
J. J. STRAFKA—*g.* General surgery
O. J. JONES—*g.* Urology
L. S. TIERN—*2.* X-ray demonstration

Wednesday

- R. C. COMBES—*g.* General surgery
JOSEPH ZIMMERMAN—*g.* General surgery
P. W. SLOAN—*3.* Fracture clinic
M. J. WINDSORE—*2.* Obstetrics

Thursday

- FRANK J. JONES—*g.* Abdominal operations.
F. B. OLSFINDER and R. C. DWYER—*g.* Thyroid surgery and
general surgical clinic
O. J. JONES—*g.* Urology
L. S. TIERN—*2.* X-ray demonstration.

Friday

- S. L. DOWLING—*g.* General surgery
A. A. BOYLE—*g.* General surgery
M. A. WINDSORE—*g.* Obstetrics

HENROTIN HOSPITAL

Tuesday

- CHANDLING BARRITT—*g.* Gynecological operations.
F. LEE STONE—*g.* Some problems in tubal patency

Wednesday

- JOHN A. GRAHAM—*12.* Open reduction of fractures.

JACKSON PARK HOSPITAL

Monday

- F. L. BARBOUR—*2.* Dry clinic: Symposium on treatment
of pulmonary tuberculosis, surgical and medical.

Tuesday

- T. H. KELLEY—*g.* General surgical clinic.
ARIEE BARMERGER—*10.* General surgical clinic.
C. C. CLARK—*11.* General surgical clinic.
S. B. MACLEOD—*1.* Fracture clinic.

Wednesday

- ARIEE BARMERGER—*g.* General surgical clinic.
H. HOYT COOK—*10.* General surgical clinic.
S. W. MARCHMONT ROBINSON—*3.* Dry clinic: Hand in-
fections as related to industrial surgery
H. F. SPIERLOW—*3.* Mortality of appendicitis.

Thursday

- ARIEE BARMERGER—*g.* General surgical clinic.
T. H. KELLEY—*10.* General surgical clinic.
G. MARCHMONT ROBINSON—*11.* Injection treatment of
hemorrhoids.
E. ALLEN PARSONS—*3.* Postoperative treatment of rup-
tured appendix with peritonitis.
R. T. FARLEY—*Chorio-epithelioma pseudo Addison's*
disease vulvula.
J. J. MOORE—*2.* Gross surgical pathology

Friday

- A. F. HEDGECOCK—*g.* General surgical clinic.
GEORGE M. LOCAS—*10.* Gynecological surgery
C. C. CLARK—*11.* General surgical clinic.

ILLINOIS CENTRAL HOSPITAL

Tuesday

- HUGH M. MACKECHUR—*g.* General surgery
PHILIP H. KIEFCHUR—*g.* Orthopedics.

Wednesday

- CHARLES PRINSTER—*g.* General surgery
BEVERIDGE MOORE—*g.* Orthopedics.

Thursday

- S. CLIMENT HOGAN—*g.* General surgery
VICTOR LEHRMANN—*g.* Genito-urinary surgery

Friday

- WILLIAM T. HANDEL—*g.* General surgery
JAMES GILL—*g.* Neurologic surgery
JOHN J. GILL—*g.* Obstetrics.
CHRISTIE GUT and A. H. BAUGHNER—*g.* Pathological con-
ference

ALBERT MERRITT BILLINGS HOSPITAL

- Staff—*g.* daily General surgical operations and clinical
demonstrations.

- WILLIAM ADAMS—*Demonstrations in thoracic surgery*
EDMUND ANDERSON—*g.* Gall-bladder surgery
ALEXANDER BRONCKOWITZ—*Management of malignant tu-
mors and experimental bone tumors*

- E. L. COMBES, C. H. HATCHER and DR. KIRBY—*Opera-
tions and demonstrations in orthopedic surgery*
LESTER R. DRAHEIM—*Surgery of the stomach and colon.*
C. B. HOGGINS and H. E. HATWOOD—*Operations and
demonstrations in genito-urinary surgery*
HILGER P. JANKINS—*Abdominal surgery*
D. B. PHARACITIS—*Bone surgery operations and demon-
strations.*

MUNICIPAL TUBERCULOSIS SANITARIUM

Tuesday

- CLEMENT L. MARTIN—9. Perianal tuberculosis.
 MINAS JOANNIDES—9. Thoracoplasty phrenic neurectomy.
 HENRY C. SWENBY—11. Pathological conference, demonstration of pathological specimens.

Wednesday

- DORRIS F. RUDRICK—9. Nephrectomy for tuberculosis of kidney; operative surgery for tuberculosis of the genito-urinary tract.
 FRANK FRIEDRICK and FRANK SWEET—10. Artificial pneumothorax.
 FREDERICK TICE, ALLAN J. HEUBY and K. J. HENRICHSEN—2. Diagnostic clinic.

Thursday

- JEROME HEAD and RICHARD DAVIDSON—9. Thoracoplasty pneumolysis, phrenic neurectomy.
 K. J. HENRICHSEN—9. Artificial pneumothorax.

Friday

- JEROME HEAD and K. J. HENRICHSEN—9. Surgical conference.

OUTPATIENT PNEUMOTHORAX CLINIC

2040 Washington Boulevard

- MINAS JOANNIDES, E. L. QUINN, EMIL BURTA and CLARA JACOBSON—9 and 2 daily. Artificial pneumothorax on ambulatory patients.

ST BERNARD'S HOSPITAL

Monday

- W. G. EPSTEIN—2. General surgery

Tuesday

- W. J. MULHOLLAND—9. General surgery
 H. HOFMAN—9. General surgery
 G. M. CUSHING—2. General surgery
 L. B. DOMKE—2. Genito-urinary surgery

Wednesday

- B. C. CUNNINGHAM and R. J. MAIER—9. Roentgenological demonstration of anomalies of spine.
 J. B. HARKERLIN—9. General surgery
 W. S. HECTOR—9. General surgery
 J. A. PARKER—2. General surgery
 S. L. GOVERNALL and S. S. MARKIEWICZ—2. Gastro-intestinal operations.

Thursday

- J. T. MEYER—9. Thyroid surgery
 F. M. PRIVER—9. Genito-urinary surgery
 W. P. GUNN—9. Gynecological operations.
 D. A. VLOEDMAN—2. Gynecological operations.
 C. C. GUY—2. Demonstration of unusual specimens.

Friday

- A. E. MCCABE—9. General surgery
 E. A. RACH and F. J. STUCKER—9. Operative obstetrical problems.

U. S. MARINE HOSPITAL

Wednesday

- O. E. NADEAU—9. General surgical clinic.

Friday

- O. E. NADEAU—9. General surgical clinic.

EVANSTON HOSPITAL

Monday

- JAMES T. CASE—2. X ray diagnosis and therapy

Tuesday

- WILLIAM R. PARKER—9. Thyroid clinic.
 MARCUS H. HOBART—9. General surgical clinic.
 DWIGHT F. CLARK—2. Recent advances in the treatment of common fractures.
 MARCUS H. HOBART—2. Fracture clinic.

Wednesday

- WILLIAM C. DANFORTH—9. Gynecological operations.
 CHARLES E. GALLOWAY—9. Gynecological operations.
 JEROME R. HEAD—9. Thoracic surgery
 FREDERICK CHRISTOPHER—2. Demonstration of surgical cases.
 ROBERT C. LONGERMAN—2. Demonstration of orthopedic cases.

Thursday

- WILLIAM C. DANFORTH—9. Gynecological operations
 JOHN L. PORTER—9. Orthopedic operations.
 WILLIAM C. DANFORTH—2. Obstetrical clinic.
 CHARLES E. GALLOWAY—2. Schiller test for the early diagnosis of carcinoma of the cervix.

Friday

- FREDERICK CHRISTOPHER—9. General surgical clinic.
 FRANCIS D. GUNN—9. Demonstration of surgical pathology.
 CHARLES E. POPE—9. Proctological clinic.
 J. EVERETT SAMNER—2. Urological clinic.

JOHN B. MURPHY HOSPITAL

Monday

- JOSEPH KERKES and R. J. MURPHY—2. Rectal treatment or appendiceal and other pelvic abscesses.

Tuesday

- H. E. DAVIS—10. Studies of epiphyseal growth disturbances.

Wednesday

- M. J. PURCELL—10. Emergency surgery
 O. H. SCHULZ—10. Observations on treatment of pneumonia.

Thursday

- F. O. BOWE—9. Treatment of puerperal infections.
 H. R. KENNY and S. J. MARK—10. General surgery

Friday

- A. C. GARVY—10. Diagnosis and treatment of skull fractures.
 H. R. KENNY and S. J. MARK—10. Pre-operative treatment in abdominal cases.

EVANGELICAL DEACONESS HOSPITAL

Tuesday

- EDWARD HEACOCK—9. General surgery

Wednesday

- PAUL MORR—9. General surgery

Thursday

- A. J. SCHOTENBERG—9. Pelvic surgery

Friday

- JOHN PEARL—9. Abdominal surgery spinal anesthesia.

CHICAGO MEMORIAL HOSPITAL

Monday

JULIA C. STRAWN and PAUL M. CLIVER—*g*. Gynecological clinic.

Tuesday

ARTHUR H. COOTLEY and FRANK M. MILLER—*g*. Orthopedic and industrial injury clinic.

JAMES E. FITZGERALD—*a*. Obstetrical clinic.
JOSEPH P. O'NEIL, J. WILLIAM PARKER and DORRIS F. RUDNICK—*a*. Urological clinic.

Wednesday

CHARLES E. KATLIER, LAWRENCE L. ISENMAN, ROBERT A. MILENBY and M. L. WIDENSTEIN—*g*. General surgical clinic.

FRANK WIDGERT—*g*. Colloidal state of the blood in post-operative pneumonia.

GEORGE M. LAUBAU—*a*. Phrenico sternals and treatment of unilateral tuberculous.

Thursday

C. R. G. FOWLER—*g*. Fracture clinic.
CARL M. EPPERT—*g*. Oral and plastic surgery.

CHARLES J. DRUECK, Sr.—*a*. Proctology.
HARRY L. MYERS—*a*. Gynecological clinic.

WILLIAM L. BROWN—*a*. Radium clinic.

Friday

PETER S. CLARK, BENNETT R. PARKER and LEO M. ZIMMERMAN—*g*. General surgical clinic.

LUTHERAN DEACONESS HOSPITAL

Tuesday

GEORGE H. SCHROEDER, JOHN KOUCY, H. C. WALLACE and G. H. MANDER—*g*. General surgical clinic.

Wednesday

GEORGE H. SCHROEDER, JOHN KOUCY, H. C. WALLACE, G. H. MANDER, R. G. WILLY and G. O. SOLER—*g*. Clinical demonstrations.

Thursday

GEORGE H. SCHROEDER, JOHN KOUCY, H. C. WALLACE and G. H. MANDER—*g*. General surgical clinic.

Friday

GEORGE H. SCHROEDER, JOHN KOUCY, H. C. WALLACE, G. H. MANDER, R. G. WILLY and G. O. SOLER—*g*. Clinical demonstrations.

ILLINOIS MASONIC HOSPITAL

Tuesday

L. WHITE—*g*. Prosthetic surgery.
O. C. RITCH—*g*. Surgery of the kidney.
CLARENCE SUGLISOT—*g*. Tumors of the testicle.

Wednesday

GILBERT FITZPATRICK—*g*. Obstetrical problems.
CHARLES PARKER and J. R. HARVEY—*g*. Gall-bladder problems.

CARL F. STEIGMANN—*g*. Medical consideration of thyroid disease.

HUGH MACKECHIE—*g*. Surgery of the thyroid.

Thursday

C. K. THOMAS—*g*. Surgical considerations of peptic ulcer.
J. F. DAVIS—*g*. Surgery of the colon.

WALTER FISCHER—*g*. Orthopedic problems of the feet.

OAK PARK HOSPITAL

Tuesday

JOHN W. TONE—*g*. General surgery.
GORDON SWANSON—*g*. Orthopedic clinic.
ARTHUR COMLEY—*g*. Management of fractures of the femur.

Wednesday

RALPH SULLIVAN—*g*. General surgical clinic, treatment of peptic ulcer.

CHARLES FOX—*g*. Gynecological operations.
CARL UTHOFF—*g*. Operative cystoscopy.

Thursday

LOUIS RIVER—*g*. General surgery.
ADOLPH KRAFT—*g*. General surgery.
CARL UTHOFF—*g*. Genito-urinary operations.

Friday

JOHN W. TONE—*g*. General surgery.
MEREDITH MURRAY—*g*. Gynecological operations.

LITTLE COMPANY OF MARY HOSPITAL

Monday

W. D. STADLER—*a*. Management of epileptic patients.

Tuesday

L. L. CHAMBER—*g*. Management of fractures about the elbow.
J. E. LAINE—*g*. Treatment of carcinoma of the bladder.

Wednesday

E. D. HUNTINGTON—*g*. Gastro-intestinal surgery complications.

Thursday

L. L. CHAMBER—*g*. Management of compound fractures.
W. A. MALONE—*g*. Radium treatment of carcinomas of the cervix.

Friday

A. W. WOODS—*g*. Gynecological repair operations.
E. D. HUNTINGTON—*g*. Intestinal obstruction.

AMERICAN HOSPITAL

Tuesday

R. B. MALCOLM—*g*. Surgical clinic, tumors of the neck.
MAX THORCK and PHILIP THORCK—*g*. Surgical clinic, carcinomas of the rectum.
W. B. GILBERT—*g*. General surgical clinic.
FRANK E. SAMPSON—*a*. Radium treatment of carcinomas of the mouth and tongue.
SOLOMON GREENSPAN and FREDERICK BOWEN—*a*. Management of placenta previa.

Wednesday

MAX THORCK and PHILIP THORCK—*g*. Surgery of the biliary tract.
HORACE E. TURNER and S. GREENSPAN—*g*. Casualty surgical clinic.
L. W. BRENNEMAN, DAVIS H. PARDELL and LEON BRILL—*g*. Urological clinic.
FRANK E. SAMPSON—*a*. Radiological clinic, carcinomas of the breast and female genitalia.

Thursday

BENJAMIN GOLDBERG and JOHN F. PIER—*g*. Indications and technique for surgery of the chest.
FRANK E. SAMPSON—*a*. Radiological clinic, indications and contra-indications to radium treatment.

RESEARCH AND EDUCATIONAL HOSPITAL

Monday

H. B. THOMAS—1. Orthopedic surgery

Tuesday

CARL A. HEDBLOM and WILLARD VAN HAZEL—9. Thoracic and general surgery
L. S. SCHULTZ—9. Oral surgery

Wednesday

ERIC OLDBERG—9. Neurological surgery
R. B. MALCOLM—9. Neurological surgery
H. B. THOMAS—1. Orthopedic surgery
F. H. FALLS—2. Obstetrical and gynecological clinic.

Thursday

CHARLES B. PUEBLOW—9. General surgery
C. M. MCKENNA—10. Urological clinic: cystoscopies.
WILLARD VAN HAZEL—2. Thoracic surgery

Friday

CARL A. HEDBLOM and WILLARD VAN HAZEL—9. Thoracic and general surgery
F. H. FALLS—2. Obstetrical and gynecological clinic.

GRANT HOSPITAL

Tuesday

ANDRE L. STAPLER—9. General surgery
F. H. FALLS—9. Gynecology
E. FISCHMANN—9. Vaginal hysterectomy
A. G. FREY—9. General surgery
GEORGE ARELLO—9. General surgery
E. HESS—10. Urology

Wednesday

E. SKIDLER—9. Abdominal resection.
A. G. ZIMMERMAN—9. General surgery

Thursday

B. H. ORNDORFF—9. Electrosurgery
W. A. STURR—9. General surgery
ANDRE L. STAPLER—2. General surgery

Friday

SYLVAN COOKES—9. General surgery
E. W. FISCHMANN—9. Pus tubes.
A. G. ZIMMERMAN—9. General surgery

POST-GRADUATE HOSPITAL

Monday

B. C. CURTWAY—2. X ray diagnosis.

Tuesday

H. SOLOWAY—10. Urological clinic.
EMIL RIES—10. Gynecological operations.
D. SCHLAPPE—2. Intraurethral prostatectomy moving picture demonstration.

Wednesday

J. C. BOODEL—10. Rectal operations.
LEO ZIMMERMAN—2. Phlebith.

Thursday

H. L. MEYERS—10. Gynecological operations.
R. A. LIPPENBAUM—11. Gynecological clinic with colposcopic demonstration.

Friday

EMIL RIES—10. Gynecological operations.

CHICAGO LYING-IN HOSPITAL

Staff FRED L. ADAMS, J. B. DELEE, WILLIAM J. DIECKMANN, M. EDWARD DAVIS, FRANK E. WHITTAKER, MANUEL SPIEGEL and H. C. HERRMANN.

Monday

Staff—2. Obstetrical operations, motion picture demonstration.

Tuesday

Staff—9. Obstetrical and gynecological operations.

Wednesday

Staff—9. Obstetrical and gynecological operations.
Staff—2. Obstetrical clinic, motion picture demonstration.

Thursday

Staff—9. Obstetrical and gynecological operations.
Staff—2. Obstetrical and gynecological dry clinic, motion picture demonstration.

Friday

Staff—9. Obstetrical and gynecological operations.
Staff—2. Obstetrical and gynecological dry clinic, motion picture demonstration.

ST JOSEPH HOSPITAL

Monday

HUGH MCKENNA—2. Review of traumatic surgery with special reference to fractures.

Tuesday

FRANKLIN B. MCCARTY—9. Surgical anatomy pathology and surgical treatment of diseases of the gall bladder
RALPH A. KORDENAT—2. Breast tumors.

Wednesday

HUGH MCKENNA—9. Abdominal surgery surgery of the large intestine.
WALTER W. VOIGT—9. Puerperal sepsis.
THOMAS J. O'DONOHUE—2. Obstetrical and gynecological operations.

Thursday

WILLIAM H. G. LOGAN—9. Cleft palate and cleft lip operations.
RALPH C. KORDENAT—2. Gall-bladder surgery

Friday

L. WADE MARTIN—9. Obstetrical clinic.

WEST SUBURBAN HOSPITAL

Monday

HARRY J. DOOLEY—2. Urological clinic.

Tuesday

WILLIAM J. POTTS—9. The healing of fractures.
OSCAR B. FUNKHOUSER—9. Gall-bladder surgery
THOMAS L. MOTTER—9. General surgery
JAMES H. SKILES—9. Gynecological clinic.

Wednesday

JOSEPH L. NORTELL—9. General surgery
FREDERICK H. FALLS—9. Gynecological clinic.

Thursday

CHARLES E. HUMISTON—9. General surgery
WARD E. POTTER—9. Thyroid clinic.
LOUIS FAULKNER—9. Interesting obstetrical conditions.
PAUL C. FOX—9. Gynecological clinic.
EUGENE C. PIETTE—9. Pathological demonstration.
HOWARD HUMISTON—2. Urological clinic.

HOLY CROSS HOSPITAL

Tuesday

- J. FRANCIS RUDIC—9. Gynecological operations: cholecystectomy, high spinal anesthesia.
 E. R. CROWDIE—9. Some practical considerations regarding the Graham test.
 JOHN F. DYBALSKI—10. Hysterectomy: spinal anesthesia.
 VINCENT TORCZYNSKI—11. Appendectomy.

Wednesday

- DONALD MORRIS—9. Thyroidectomy: lecture on avertin anesthesia.
 A. R. McCRAE—10. Hernia operation.
 PAUL LAWLER—11. Low cervical cesarean section.

Thursday

- STEPHEN BILES—9. Gynecological operations.
 MICHAEL STRICK—9. Cholecystectomy.
 F. F. FRAIDER—11. Panhysterectomy.

Friday

- M. J. BADENHOWER—9. Thyroidectomy: hysterectomy.
 RICHARD ROCKE—10. Herniorrhaphy.
 J. FRANCIS RUDIC—Pre- and postoperative therapy.

ST ANNE'S HOSPITAL

Tuesday

- T. E. MEANY—9. Orthopedic clinic.
 J. L. KRAFT—11. General surgery.
 J. B. HANNEY—2. X-ray demonstration.

Wednesday

- G. F. THOMPSON—9. Stomach and intestinal surgery.
 J. W. MCCONNELL—10. Gynecology.
 J. J. GEARIN—11. General surgery.

Thursday

- H. J. DOOLEY—9. Urological clinic.
 E. P. VAUGHAN—9. Gall-bladder surgery.
 E. P. GRANGER—1. Treatment of head injuries.
 J. L. FLEMING—Pathological obstetrics.

Friday

- B. W. MACK—9. General surgery.
 Staff—9. Clinical meeting.
 D. F. HAYES—11. General surgery.
 L. R. HILL—2. Pathological demonstration.

SHRINERS' HOSPITAL

Tuesday

- BEVERIDGE MOORE and HAROLD SOTFIELD—9. Orthopedic operations.

Wednesday

- BEVERIDGE MOORE—8. Demonstration of plaster technique: club foot clinic.

Thursday

- BEVERIDGE MOORE and HAROLD SOTFIELD—9. Orthopedic operations.

Friday

- BEVERIDGE MOORE and HAROLD SOTFIELD—2. Out-patient clinic.

SOUTH CHICAGO COMMUNITY HOSPITAL

Tuesday

- M. E. FINNEY—2. Avertin anesthesia, analysis of 200 cases.
 LOUIS D. SMITH—30. Tuberculous of the kidney: presentation of case.

Friday

- JOSEPH J. LEBOWITZ—1. Fractures and dislocations of the elbow: presentation of cases treated by open operation.
 FRANK G. MURPHY—20. Fractures of the upper end of the humerus, presentation of cases.
 GEORGE G. O'BRIEN—3. Postoperative evisceration, presentation of case.

FRANCES L. WILLARD HOSPITAL

Tuesday

- ALLEN E. STEWART—9. General surgical clinic.
 FREDERICK MUELLER—3. Surgery of bones and joints.

Wednesday

- OTIS M. WALTER—9. General surgical clinic.
 VAUGHN L. SKEETS—10. Diabetic clinic.

Thursday

- JOSEPH F. JAROS—9. Thyroid clinic.

Friday

- VICTOR L. SCHLAGER—9. General surgical clinic.

ALEXIAN BROTHERS HOSPITAL

Tuesday

- MALCOLM L. HARRIS, AUGUST ZIMMERMAN, ROBERT FLANDORF and GEORGE L. APPELSACK—9. General surgery.
 A. WOODSKI and EDWARD WHITE—9. General surgery.

SURGERY OF THE EYE, EAR, NOSE AND THROAT

COOK COUNTY HOSPITAL

Monday

EARLE B. FOWLER—2. Ophthalmoscopy
S. PEARLMAN and N. LESHIN—2. Esophagoscopy and bronchoscopy; surgery of the neck.

Tuesday

THOMAS D. ALLEN—2. External diseases of the eye.
I. MURKAT—2. Clinical and surgical otolaryngology; plastic surgery of face and nose.

Wednesday

L. T. CURRY—9. Otolaryngology clinical and surgical cases.
WILLIAM F. MOWCROFT—9. Ophthalmic neurology and ophthalmoscopy

Thursday

SAMUEL R. GIFFORD—9. Ophthalmic surgery.
CHARLES F. YENGER—11. External diseases of the eye.
S. PEARLMAN and N. LESHIN—2. Esophagoscopy and bronchoscopy; surgery of the neck.

Friday

T. C. GALLOWAY and M. T. LAMPERT—10. Malignancy about the head diathermy
THOMAS D. ALLEN—2. Ophthalmic surgery
I. MURKAT—2. Clinical and surgical otolaryngology plastic surgery of face and nose.

ST LUKE'S HOSPITAL

Monday

EARL VERNON—2. Ophthalmological clinic.

Tuesday

E. FINDLAY and RICHARD GAMBLE—1. Ophthalmological clinic.
J. T. CAMPBELL, JOHN A. CAVANAUGH, HORACE R. LYONS, E. P. NORCROSS and WALTER H. THEOBALD—2. Otolaryngological clinic.

Wednesday

ALVA SOWERS—1. Ophthalmological clinic.
J. T. CAMPBELL, JOHN A. CAVANAUGH, HORACE R. LYONS, E. P. NORCROSS and WALTER H. THEOBALD—2. Otolaryngological clinic.

Thursday

FRANK BRANTLEY and JAMES W. CLARK—1. Ophthalmological clinic.
J. T. CAMPBELL, JOHN A. CAVANAUGH, HORACE R. LYONS, E. P. NORCROSS and WALTER H. THEOBALD—2. Otolaryngological clinic.

Friday

E. FINDLAY and RICHARD GAMBLE—1. Ophthalmological clinic.

ILLINOIS CENTRAL HOSPITAL

Tuesday

HIRAM SMITH—9. Eye clinic.

Wednesday

JAMES H. McLAUGHLIN—9. Nose and throat surgery

CHICAGO EYE, EAR, NOSE AND THROAT HOSPITAL

Tuesday

H. B. FULLER—9. Mastoid surgery
WILLIAM A. HOFFMAN and WILLIAM LINGARD—9. Ear nose and throat clinic.
WILLIAM A. FISHER—9. Cataract operations.
WILLIAM A. HOFFMAN—9. Eye clinic.
L. SAVITT—10. Removal of tonsils by diathermy
OSCAR B. NOGENT—11. Eye clinic.
O. M. STEFFENSON—11. Ear nose and throat clinic.
T. S. KAMMERLING—2. Eye, ear nose and throat clinic.

Wednesday

O. M. STEFFENSON—9. Tonsil dissection.
WILLIAM A. HOFFMAN and WILLIAM LINGARD—9. Nasal surgery and ear nose and throat clinic.
OSCAR B. NOGENT—9. Cataract operations.
WILLIAM A. HOFFMAN—9. Eye clinic.
OSCAR B. NOGENT—11. Eye clinic.
O. M. STEFFENSON—11. Ear nose and throat clinic.
L. SAVITT—11. Ear, nose and throat clinic.
H. B. FULLER—2. Eye, ear nose and throat clinic.

Thursday

WILLIAM A. FISHER—9. Eye operations.
WILLIAM A. HOFFMAN—9. Eye clinic.
T. S. KAMMERLING—9. Surgery of the nasal accessory sinuses.
WILLIAM A. HOFFMAN and WILLIAM LINGARD—9. Ear nose and throat clinic.
L. SAVITT—10. Physical measures in otolaryngology
O. M. STEFFENSON—11. Ear nose and throat clinic.
L. SAVITT—11. Ear nose and throat clinic.
OSCAR B. NOGENT—11. Eye clinic.
T. S. KAMMERLING—2. Eye, ear nose and throat clinic.

Friday

O. M. STEFFENSON—9. Tonsil dissection.
WILLIAM A. HOFFMAN and WILLIAM LINGARD—9. Ear nose and throat clinic.
OSCAR B. NOGENT—9. Fundus photography and pathology
WILLIAM A. HOFFMAN—9. Eye clinic.
H. B. FULLER—10. Functional testing
O. M. STEFFENSON—11. Ear nose and throat clinic.
OSCAR B. NOGENT—11. Eye clinic.
H. B. FULLER—2. Eye ear nose and throat clinic.

MERCY HOSPITAL

Tuesday

GEORGE T. JORDAN—9. Nasal ganglion.
L. G. HOFFMAN—9. Cataract extractions
C. H. CHRISTOPHER—9. Bronchoscopy

Wednesday

GEORGE MUGRAVE and ALFRED PAINLEY—9. Frontal sinus operation, local anesthesia, modified radical mastoid operation with complete removal of flap presentation of cases.

Thursday

ULYSES J. GRIM—9. Radical antrum and mastoid.
DEMO O. CONNOR and RAY KIRWIN—9. Ocular tumors.
CARL SCHAU—9. Focal infection in iritis.

RESEARCH AND EDUCATIONAL HOSPITAL

Otolaryngological Staff: F. L. LEONARD, W. H. THEOBALD
J. J. THEOBALD, G. S. LIVINGSTON, E. A. BREIDENBACH,
N. FOX, S. L. SHAPIRO, L. G. SPEDMAN, P. A. HALPER,
A. C. KAKE, A. COOKES, J. HARRISON, O. VAN ALSTED,
M. CUTMAN, S. MOWITZ, M. OSTROM, B. LAM-
BRIDGE, E. HARTLEY, H. KLAUW, L. FORDMAN,
H. WADSWORTH, J. BELLON and N. FARRINGTON
Ophthalmological Staff: HALLARD BEARD, M. L. FOLK,
H. J. SMITH, S. WOLF, S. KAUFMAN, CARL APPLE
and J. W. CLARK.

Monday

Staff—3. Otolaryngological out-patient clinic

Tuesday

Staff—9. Ophthalmological clinic, operations and demonstrations.

Staff—10. Otolaryngological out-patient clinic.

Staff—9. Otolaryngological clinic, operations and demonstrations

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Staff—9. Eye clinic

Staff—10. Otolaryngological out-patient clinic.

Staff—3. Otolaryngological out-patient clinic.

Staff—4. Otolaryngological seminar

Thursday

Staff—9. Otolaryngological operations.

Staff—10. Eye clinic.

Staff—10. Otolaryngological out-patient clinic

Staff—3. Otolaryngological clinic, operations and demonstrations

Staff—3. Otolaryngological out-patient clinic

Friday

Staff—9. Eye clinic, operations and demonstrations.

Staff—10. Otolaryngological out-patient clinic

Staff—3. Otolaryngological out-patient clinic

CHICAGO MEMORIAL HOSPITAL

Monday

EDWARD H. STREET and RICHARD W. WATKINS—3
Otolaryngological clinic.

Tuesday

HERMAN P. DAVIDSON and GLENWAY W. NEUBERG—9
Eye clinic.

Wednesday

ALFRED E. LEWY and IRVING I. MURKAT—2. Otolaryngological clinic.

EVANSTON HOSPITAL

Tuesday

THEOBALD C. GALLOWAY—9. Otolaryngological clinic.

Thursday

HOWARD C. BALLENGER—9. Otolaryngological clinic.

Friday

GAIL R. SOMER—3. Lesions of the fundus oculi, lantern slide demonstration.

WASHINGTON BOULEVARD HOSPITAL

Tuesday

L. McBRIDE—2. Nose and throat clinic.

Wednesday

VIRGIN WESTCOTT—2. Eye clinic.

ILLINOIS EYE AND EAR INFIRMARY

Tuesday

DWIGHT C. OGDEN—9. Use of flap in cataract work, superior rectus tension suture plastic.

LEROY THOMPSON—9. Industrial ophthalmology

CARL H. CHRISTENSEN—10. Bronchocopy, otoscopy, otology

M. A. GLATT—1. Radical mastoid and radical frontal operations.

E. R. CHAMBERLAIN—2. Intra- and extra-ocular surgery

OSCAR CLARK—3. Radical mastoid operation.

Wednesday

M. LEONARDSON—9. Detachment of retina, cataracts, trichiasis

Staff—10. Dry clinic

WILFRED J. GRIFF—1. Radical mastoid and radical antrum operations.

MICHAEL GOLDENBERG—2. Intraocular operation for glaucoma, cataracts, controlled tenotomy

JOHN A. CAVANAGH—3. Radical mastoid operation.

Thursday

HENRY WALKER—9. Detachment of retina, Lensec operation

C. F. YERGEN—10. Radical antrum and radical mastoid operations

A. LEWY—1. Radical frontal operation.

E. K. FROST—2. Intra- and extra-ocular surgery

W. A. CHASE—3. Tonics, diathermy

MOUNT SINAI HOSPITAL

Monday

JOSEPH C. BECK, ALFRED LEWY, NOAH SCHOENMAN,
JACOB LEIBOWITZ, S. M. MOWITZ and associates—2. Ear, nose and throat operations

Friday

JOSEPH C. BECK, ALFRED LEWY, JACOB LEIBOWITZ, NOAH SCHOENMAN, S. M. MOWITZ and associates—9. Ear, nose and throat operations.

JAMES E. LEONARDSON—9. Operations for cataract and squint.

Daily p. m.'s

JAMES E. LEONARDSON. Eye changes in hypertensive states.

ALFRED LEWY and S. M. MOWITZ. Otogenic asplasia.

WEST SUBURBAN HOSPITAL

Monday

ROBERT H. GOOD—2. Surgery of the nose, motion picture demonstration.

Tuesday

JOHN J. THEOBALD—2. Mastoid surgery

Wednesday

GEORGINA THEOBALD—2. Eye pathological exhibit.

ILLINOIS MASONIC HOSPITAL

Tuesday

M. H. COTTELL—10. Some advances in mastoid work.

B. M. WOLFE—10. Tonsil surgery in the poor risk cases

H. E. TAYLOR—10. Conservative surgery of the nose.

EVANGELICAL HOSPITAL

G. HENRY MURPHY. Technique and interpretation of hearing tests and techniques and interpretation of tests of the static labyrinth.

PRESBYTERIAN HOSPITAL AND RUSH MEDICAL COLLEGE

Monday

- D. B. HAYDEN—2. Complications of otitis media without rupture of the tympanic membrane.
E. W. HAGENS—2. Unusual laryngeal and bronchial case.
GEORGE E. BRAMBRIDGE, JR. and E. W. HAGENS—2. Operations on the tear sac for dacryocystitis.
MAX JACOBSON—3. Neurological aspects.

Tuesday

- ROBERT VON DER HEYDT—3. Slit lamp diagnostic clinic.

Wednesday

- VERNON LEECH—3. Glaucoma.

Thursday

- BERTHA KLEIN—10. Histopathology of fundus.
T. W. LEWIS—2. Discussion of some difficult problems in the operation for correction of the nasal septum.
L. T. COBBY—2. Demonstration of skiagraphs of the sinuses and mastoids.
R. W. WATKINS—2. Nasal findings in allergic cases.
W. J. JONKER—2. Diathermy and its application to the treatment of nose and throat conditions.

Friday

- W. F. MONTGOMERY—10. External diseases of the eye and iridocyclitis.
ELIAS SELINGER—3. Fundus.

MICHAEL REESE HOSPITAL

Monday

- H. S. GRADLE—2 30. Eye surgery

Tuesday

- S. J. PERLMAN—9. Bronchoscopic clinic.
M. L. FOLK—2. Eye surgery

Wednesday

- SAMUEL SALINGER—9. Nasal fractures plastic of the nose.
M. L. FOLK—2. Eye clinic.
H. S. GRADLE—2 30. Surgical eye clinic.
ROBERT VON DER HEYDT—3. Slit-lamp demonstration.

Thursday

- CARPER EMBERT—9. Cleft palate and harelip.
S. J. MEYER—2. Eye clinic.

WOMEN AND CHILDREN'S HOSPITAL

Tuesday

- ALICE K. HALL—10. Nose and throat clinic.

Wednesday

- FRANCIS HARKER—10. Nose and throat clinic.

ST ANNE'S HOSPITAL

Tuesday

- B. T. GORDON—9. Nose and throat clinic.

Wednesday

- V. K. GRAY—9. Eye and ear clinic.

AUGUSTANA HOSPITAL

Wednesday

- ALFRED MCCREY—2. Eye, ear nose and throat clinic.

ALBERT MERRITT BILLINGS HOSPITAL

Tuesday

- E. V. L. BROWN—9. Eye clinic.
J. R. LINDSAY—10 30. Ear nose and throat clinic.
DEWEY KATZ—2. Eye clinic.

Wednesday

- LOUIS BOTHEMAN—9. Eye clinic.
T. E. WALSH—10 30. Ear nose and throat clinic.
JOHN STOUGH—2. Eye clinic.
J. R. LINDSAY and G. H. SCOTT—2. Ear nose and throat operations.

Thursday

- P. C. KRONFELD—9. Eye clinic.
G. H. SCOTT and H. B. PERLMAN—10 30. Ear nose and throat clinic.
DEWEY KATZ—2. Eye clinic.

Friday

- DEWEY KATZ—9. Eye clinic.
J. R. LINDSAY and T. E. WALSH—10 30. Ear nose and throat clinic.
P. C. KRONFELD—2. Eye clinic.
T. E. WALSH and H. B. PERLMAN—2. Ear nose and throat operations.

COLUMBUS HOSPITAL

Monday

- MICHAEL GOLDENBURG—2. Emergency surgery of the eye

Wednesday

- G. B. LAMBRACKS—9. Indications for operative treatment in acute mastoiditis.
S. SCHIACETTA—9. Otolaryngological clinic.
MICHAEL GOLDENBURG—2. Eye surgery

Friday

- MICHAEL GOLDENBURG—2. Eye surgery

OAK PARK HOSPITAL

Tuesday

- HOWARD RIORDAN—9. Demonstration of new nasopharyngoscope on the cadaver and living

Thursday

- HOWARD RIORDAN—9. Treatment of maxillary sinusitis with the cold quartz lamp new method of treatment of maxillary polyp by diathermy

Friday

- GEORGINA THORNTON—9. Demonstration of eye tumors ophthalmic surgery

SOUTH SHORE HOSPITAL

Monday

- JOHN W. STANTON—2. Mastoiditis and its complications.

Thursday

- JOHN W. STANTON—11. Otolaryngological surgery

JACKSON PARK HOSPITAL

Tuesday

- H. E. L. TINK—1. Tinnin's modification of Shuder ton-allotory

JOHN B. MURPHY HOSPITAL

Monday

E. F. GARRAGHAN—s. Eye operations.

Tuesday

L. H. WOLF and PAUL WOLF—10. Mastoid surgery

Friday

GEORGE W. MARONEY—p. Cataracts.

AMERICAN HOSPITAL

Tuesday

HARRY L. POLLOCK and Associates—s. Ear nose and throat clinic.

Wednesday

OSCAR KRAFT—s. Ophthalmological clinic.

GRANT HOSPITAL

Wednesday

S. H. SOMEROBY—p. Ear, nose and throat clinic.

GEORGE F. SCHER—p. Eye clinic.

GEORGE DENNET—g. Eye, ear nose and throat clinic.

ST. MARY OF NAZARETH HOSPITAL

Tuesday

J. J. KILGORE—g. Ear nose and throat clinic.

Thursday

J. J. KILGORE—g. Ear nose and throat clinic.

RAVENSWOOD HOSPITAL

Wednesday

A. V. MURRAY—o go. Malignancies of the eye.

PASSAVANT MEMORIAL HOSPITAL

*Friday*J. GORDON WOODS, JOHN DILLON, CARL BOOKWALTER and ELLISON ROSE—p. Ear nose and throat clinic.
SANFORD GIFFORD, WILLIAM ALARY JR. and RALPH DAVIS—11. Ophthalmology

CHILDREN'S MEMORIAL HOSPITAL

Wednesday

GEORGE S. LIVINGSTON and staff—g. Otolaryngological clinic.

RICHARD C. GAMBLE and staff—s. Ophthalmological clinic.

FRANCES E. WILLARD HOSPITAL

Thursday

WILLARD D. BROWN—10. Surgery of throat and nose.

LITTLE COMPANY OF MARY HOSPITAL

Wednesday

H. T. NASH—10. Emergency surgery of the eye.

SOUTH CHICAGO COMMUNITY HOSPITAL

Tuesday

GEORGE E. PARK—g. The center of ocular rotation in the horizontal plane.

ST. BERNARD'S HOSPITAL

Friday

PHILIP O'CONNOR—s. Surgery of the eye dry clinic.

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ACUTE INTERSTITIAL PANCREATITIS

A CLINICAL STUDY OF THIRTY SEVEN CASES SHOWING OEDEMA, SWELLING AND INDURATION OF THE PANCREAS BUT WITHOUT NECROSIS HÆMORRHAGE, OR SUPPURATION¹

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TO establish as a clinical and pathological entity the undoubted occurrence of a special type of acute pancreatic disease, tentatively designated as acute interstitial pancreatitis is the immediate purpose of this paper. Originally suggested in 1922 by Zoepffel under the title of acute oedema of the pancreas, attention was called to it later in this continent in a paper by Archibald. Several similar cases observed in this clinic prompted an investigation of the literature which revealed reports of instances elsewhere indicating that this type of pancreatitis is more common than is supposed. That these cases represent a special variety of acute pancreatitis is shown by the absence of actual necrosis, suppuration and hæmorrhage the most important anatomical findings being confined to oedema swelling and induration of the gland. The symptoms while acute and severe are also different in that they are apt to subside unlike the progressive downward course in acute pancreatic necrosis. It is of additional interest finally that in most of these cases diagnosis was incorrect, the attack being commonly considered as due to biliary colic intestinal obstruction, or perforated ulcer the error being discovered at operation when often only an oedema enlargement or induration of the pancreas was noted.

PRESENTATION OF DATA

The evidence that we are dealing with a definite type of pancreatic disease consists in this report of a clinical analysis of 37 cases 4 of them observed in this clinic. Anatomical observations of the pancreas were made in all cases and in 6 of them included a study of microscopic sections.

The previous literature on disease of the pancreas in general contained little discussion of the type of pancreatitis now under consideration. Thus examination of the various monographs by pathologists, including the exhaustive system of Henke and Lubarsch revealed practically no mention of the occurrence of an acute subsiding inflammation of the pancreas in which oedema and induration are the prominent findings. A type of acute pancreatitis is described without necrosis or hæmorrhage which occurs in mumps typhoid and other specific diseases, but I shall not be concerned with such secondary infections. The medical (non-surgical) literature has also failed to furnish significant data, because in them anatomical studies were absent. Many cases are described which were assumed to have acute subsiding pancreatitis of some type, the diagnosis being based on the clinical picture and often on ferment studies or occasionally the presence of glycosuria. Such cases

have been discussed in some detail by Katsch and by Einhorn. Since no anatomical observations were recorded in these reports, they were not considered in this survey. We were left therefore with the surgical literature which was analyzed as thoroughly as possible first by consulting the older monographs, which in general catalogued only cases of frank necrosis usually far advanced; second, by the more recent literature. In all 33 cases were collected. Some of these were found reported under the title of oedematous pancreatitis; others were culled from among case reports of ordinary acute pancreatitis.

In collecting this data cases were selected according to certain criteria. Briefly they were records of patients with fairly characteristic acute abdominal symptoms referable more or less to the pancreas, but who at operation showed in the pancreas no suppurative necrosis or hemorrhage, but definite edema swelling induration and in those studied with microscopic sections acute inflammatory infiltration of the interstitial tissue of the gland. Although there are doubtless many more cases on record the 33 instances herein collected seem sufficient for adequate analysis, especially when studied together with the 4 cases observed in this clinic. Brief protocols of all cases will be presented and in addition a tabular summary of the salient features in a separate chart.

PREVIOUS LITERATURE

In Koerte's monograph published in 1898 mention is made of several cases in which acute abdominal symptoms occurred diagnosed usually as intestinal obstruction but in which at operation only an edema of the pancreas was found without actual necrosis although in many instances involvement of the peripancreatic tissue with multiple pin point areas of fat necrosis was made out. The source of these cases was not indicated. He described one of them as follows:

CASE 1: Patient was operated upon in 1890 by Dr. W. S. Halsted for intestinal obstruction. No obstruction was found, but pin point areas of fat necrosis and a hard indurated pancreas were discovered. The abdomen was closed and recovery followed. Koerte stated that this patient had a subsequent and similar attack 4 years later which cleared

up spontaneously. Dr. Halsted, in a later report, however writes that he had misinformed Dr. Koerte about the subsequent attacks. It was in another case altogether.

In the monograph of Mayo-Robson and Moynihan published in 1902 there is a discussion of subacute pancreatitis associated with suppurative catarrh of the pancreatic ducts analogous to suppurative cholangitis. These patients were said to have had acute attacks of epigastric discomfort and pain with symptoms of dyspepsia and tenderness over the pancreas. They believed that some of these cases ended in chronic interstitial pancreatitis. A number of them were operated on in the chronic stage but no observations were apparently made of the pancreas during an acute attack.

Opie discussed and cited several cases of acute interstitial inflammation resulting however in suppuration although by analogy with similar inflammations in other organs he suggested that resolution with recovery may occur or that it might lead to chronic pancreatitis. Heberg in 1914 mentioned acute interstitial pancreatitis, without suppuration which may disappear spontaneously. He believed its greatest significance was that it represented an early stage of chronic pancreatitis. No cases were cited.

In 1919 a case was described by Mercadé which was apparently a definite instance of acute oedematous pancreatitis. It was reported as a case of acute pancreatitis syndrome of intestinal obstruction.

CASE 2: A female 30 years of age with negative history, was seized with violent epigastric pain followed by vomiting; distention developed, and the general condition became worse with a fast pulse and a temperature of 38 degrees C. On examination, aside from distention, nothing noteworthy was made out. Diagnosis: intestinal obstruction. Operation, 24 hours after onset of attack, revealed yellowish peritoneal fluid, and extreme fat necrosis. Pancreas revealed no hemorrhage, it was simply hypertrophied and indurated. A drain was placed to the surface of the pancreas and the wound closed. Recovery was uneventful.

Zoeppfel in 1922 described 4 cases in detail in which at operation the pancreas was the site of a glassy edema the parenchyma swollen and hard. Biopsy in 2 cases showed on

section no necrosis, but an inflammatory oedema. In all of them cholecystectomy, choledochostomy and drainage of the pancreas were done at operation followed by recovery in all. He distinguished these cases anatomically from 7 others of acute pancreatitis by the absence of (1) gland necrosis and (2) haemorrhage. Areas of fat necrosis did not help in the differentiation since they were present in 2 of the 4 cases of oedema. He considered the oedema, however, as the first step in the development of acute necrosis and that these were therefore early cases. He believed further, that acute pancreatitis is always secondary to disease of the gall bladder. The symptoms of acute inflammation of the pancreas were differentiated from gall stone colic by the greater severity of the pain, its localization, with tenderness to the mid epigastrium and to the left of the midline and occasionally by glycosuria. He also mentioned another series of 115 operations for acute cholecystitis in which he found pancreatic oedema in 11. Protocols of the 4 cases described as acute oedema are as follows:

CASE 3. Female aged 45 years suffered for 5 years with gall-stone pain and had an especially severe attack a few hours before admission, with repeated vomiting. There was a slight icterus on examination, epigastric rigidity and tenderness, and slight glycosuria. At operation, performed at once the gall bladder was found to be filled with stones. The pancreas in its entire extent was swollen, hard, and the site of a glassy oedema there was a slight fat necrosis of capsule. Biopsy showed intact cells with inflammatory oedema.

CASE 4. Male aged 40 years had for 4 weeks almost daily attacks of abdominal pain which were much more severe the night before admission. Examination showed a slight icterus, slight cyanosis, white blood cells 15,000 and tenderness in epigastrium and under the right rib margin. At operation there were seen numerous areas of fat necrosis, in the gall bladder were two large stones, the common duct was dilated, the papilla of Vater patent and the pancreas swollen and oedematous.

CASE 5. Male aged 31 years, had "stomach trouble" for 9 months, consisting of pain after eating and vomiting. Four days ago he suffered a renewed attack which became suddenly more severe a few hours before admission. Examination revealed a sick patient, icteric with tense tender epigastrium extending to left and also to right and white blood cells 15,000. Operation revealed a severe acute cholecystitis with stones and pus in the gall bladder

dilated common duct, patent papilla of Vater and pancreas swollen and markedly oedematous.

CASE 6. Female, aged 47 years, had two severe gall-stone attacks before the present one which began on the evening before admission. Pain radiated between shoulder blades and back and she vomited persistently. Examination showed a sick patient with tense abdomen and tenderness in epigastrium and over gall bladder region. At operation the gall bladder was found to be small, but inflamed, contained stones, the common duct was not dilated, the pancreas was large, hard and oedematous confined, however to the head of the gland. Biopsy showed a spongy inflammatory infiltration cells not damaged.

Analysis of the German literature since the paper of Zoepffel's reveals continued reference to his observations but few further cases were reported as acute oedematous pancreatitis. Thus Gross and Guleke in their extensive monograph, mentioned pancreatic oedema only as a possible early stage of acute necrosis. One of their described cases however seemed characteristic. The pancreas moreover looked similar grossly to the gland found in one of the cases reported by the present author (Case 37) in which microscopic examination of the pancreas showed only acute interstitial inflammation. A summary of their case follows:

CASE 7. Female aged 51 years, had attacks of gall-stone colic for 8 years of 1 to 3 days duration with vomiting and icterus. She was seen 3 days after the onset of an especially severe attack with cramping pain in the epigastrium vomiting and constipation. There was a definite transverse area of tenderness above the umbilicus most marked below the left rib margin. Operation at once revealed a pancreas double its normal size, hard, dark red and with yellowish areas of fat necrosis and sero-sanguineous peritoneal fluid. There were no areas of softening in the gland which was split lengthwise and packed. The gall bladder was thick and contained stones which were removed and the gall bladder was drained. Recovery was complete.

In the extensive paper by Schmieden and Sebenius the data from 2137 cases of pancreatitis obtained from 148 clinics and hospitals of Germany during the 8 years preceding 1927 were examined. Mention is made of oedema as part of the pathology of acute pancreatitis referring to Zoepffel's idea that it is really an early stage of acute necrosis although they suggest that it "may subside" without

leaving any alteration in the gland. Never theless in presenting the anatomical findings in their cases of acute pancreatitis, one is struck by the fact that 92 per cent of them showed only edema without fat necrosis, 35.4 per cent edema with fat necrosis, and that only 56 per cent (the remainder) showed hemorrhagic infarction, necrosis, softening, sequestration or abscess. They confirmed the observation of Zoepffel in that in patients operated on for acute cholecystitis they have noted a peripancreatic edema, especially of the head with no fat necrosis or exudate. On the other hand, unlike Zoepffel who considered acute pancreatitis as inseparable from gall bladder disease, they found biliary disease in only 69.8 per cent of their 1278 cases of acute pancreatitis, and quoted Guleke who found only 47.6 per cent in another series of 437 cases. Walzel, in 52 cases, saw after incising the capsule, only 3 with a high grade edema of the entire pancreas without visible necrosis or hemorrhage. He did not believe that the edema met with in early operations has anything to do with the type of pancreatitis which goes on to necrosis. In this sense he, too deviated from the idea expressed by Zoepffel. No case reports were recorded, nor was there any further discussion of the nature or significance of this edema. Kerschner reported 41 cases of which 7 showed only edema or edema and fat necrosis but without hemorrhage or necrosis. All of his cases had definite gall bladder disease.

Coming to American authors, Archibald was the first to write specifically of acute pancreatic edema. He considered in some detail its pathogenesis presenting experimental evidence which will be discussed later on. He described one case as follows:

CASE 8. Male, aged 36 years, had had eight attacks in 1 year of severe generalized abdominal pain with radiation to back and shoulders. The last attack began 6 days before admission and remained severe in spite of heavy doses of morphia. Vomiting occurred occasionally. Examination revealed a rather scaphoid abdomen great tenderness in the epigastrium, if anything more marked to the right of the median line, though extending to the left. White blood cells, 11,600 and a left-sided zone of hyperesthesia at the level of the umbilicus. Lipase was found in the urine as against normal controls, but disappeared several days later. At operation, per-

formed when the attack was subsiding, the peritoneum was perfectly clear. Liver normal looking, gall bladder partly filled with bile and seemed healthy contained no stones, the common duct felt normal, the pancreas felt large, was hard, and the change involved the entire organ. The appendix was removed and the abdomen was closed with drainage. Recovery was uneventful. He was seen 2 months later in another similar attack lasting 6 days for which only symptomatic treatment was given. This time a definite area of extreme tenderness was made out on thumb pressure 2 inches wide midway between umbilicus and ensiform, extending one inch to the right and two and one-half inches to the left of the midline. One year later he had another attack or two.

In consulting other papers on pancreatitis by American authors one finds frequent mention of the finding at operation of pancreatic swelling or edema without necrosis or hemorrhage, but aside from the paper of Stetten its significance was not discussed. Thus Colp in a review of 85 cases, stated simply that the pancreas at operation in a majority of cases was described as hard and enlarged. McWhorter analyzed 64 cases of acute pancreatitis treated by members of the Chicago Surgical Society up to 1924. There were 18 cases among them of acute or subacute pancreatitis in which no hemorrhage was seen or recorded and in which the pancreas was usually enlarged edematous, and hard. All but 4 of these cases had had a previous history of attacks. Two of the 18 cases recovered following laparotomy only. Of the entire series of 64 cases there was a history of previous attacks of acute abdominal pain in 24, or 37 per cent, and "2 had been previously operated on for a condition diagnosed as chronic recurring appendicitis. Of those complaining of previous attacks of abdominal pain 21 showed no gall stones or cholecystitis, 17 at operation and 4 at autopsy from which the inference is drawn that unless a previous lesion of the gall bladder had healed and left little or no trace these previous attacks were due to mild attacks of pancreatitis. Linder and Morse reported 88 cases of acute pancreatitis in which over half or 49 cases, at operation showed in the pancreas only edema and enlargement. Three cases were described. Two of them were undoubtedly cases of non hemorrhagic pancreatitis. In one of them no mention was

made of the appearance of the pancreas, though fat necrosis and serosanguineous fluid were found.

The other (CASE 9) a female, 52, had many attacks of epigastric pain radiating to back and shoulders for 1 year and recently every week or two accompanied by vomiting, chills, and fever. Physical examination revealed tenderness in the epigastrium and left lumbar region, no jaundice, temperature 100.8 degrees F, pulse 88. Operative findings: gall bladder was thin, but contained many stones; fat necrosis in abdomen; pancreas swollen and indurated. Cholecystectomy was followed by recovery.

Writing under the title of "subacute pancreatitis or so-called acute edema of the pancreas" Stetten reported 3 cases, 2 of which are especially interesting because they probably had uncomplicated lesions. He emphasized the importance of recognizing this type of disease in the pancreas, but agreed with Zoepffel that it represents a type of pancreatitis seen as an early stage of pancreatic necrosis, although both of the following cases were operated on days after the onset of the attack and yet showed no necrosis.

CASE 10. A male, aged 46 years, previously healthy was awakened one morning with severe diffuse abdominal pain referred especially to the epigastrium for which morphia effected some relief. The pain recurred and radiated to the back and left side. On examination there was found some deep tenderness in the epigastrium but no rigidity; temperature was 100.8 degrees F, pulse 80, and white blood cell count normal. The pain continued to recur, requiring morphia for its relief. There was a definite radiation to the left. Operation 4 days after the onset of the first pain revealed a slightly thickened gall bladder which was removed and contained no stones. None was felt in the rest of the biliary tract. Stomach and duodenum were negative. The pancreas was enlarged to half again its normal size and the entire organ was indurated. The peritoneum overlying it was intensely injected and edematous but no suppurative hemorrhage, or necrosis was made out. The pancreas was split lengthwise and drained. The deep epigastric pain ceased almost immediately after operation. In spite of a stormy course recovery was complete.

CASE 11. A male, aged 39 years, was seen 2 years before, complaining of severe pain in the upper abdomen radiating to the back from which he had suffered for 3 years. He was discharged after a 2 months' period of observation the various examinations suggesting only the possibility of a duodenal ulcer. On his readmission he stated that he was well until 4 months before when he began to have a sense

of pressure and later deep dull pain in the mid epigastrium and back radiating to the right side. Two weeks before it assumed a knife-like and severer quality, requiring large amounts of sedatives. On examination he showed tenderness to deep epigastric pressure, but no rigidity. Routine examinations were negative. A diagnosis of duodenal ulcer was made. At operation a normal gall bladder was seen with a few pericholecystic adhesions, but no stones were felt in the gall bladder common duct or ampulla. Pancreas was enlarged and indurated, especially at the head which was also nodular. Enlarged glands were present over the head and one was removed for study. The pancreas was incised and seemed thickened, edematous and bled profusely. It was drained. Recovery was uneventful except for occasional deep epigastric pain. Glycosuria persisted for 12 days and disappeared. Section of the lymph gland showed chronic lymphadenitis.

The English literature revealed a number of cases of interest in this survey. Thus in the *British Journal of Surgery* under the section "Instructive Mistakes" is the case of a patient who at operation showed extensive edema around the pancreas (10). It was reported as a case of "gall stones and acute pancreatitis simulating perforated gastric ulcer."

CASE 12. A female, aged 44 years 2 days before admission, was seized with sudden epigastric pain which assumed an intermittent colic like character and radiated especially to the small of the back. She vomited repeatedly. Examination revealed a generally tender abdomen of board like rigidity, especially in the epigastrium. Operation disclosed pale yellow peritoneal fluid. The omentum and mesocolon were edematous and bile stained and one small area of fat necrosis was noted. The head and about 1 inch of the body of the pancreas formed a hard mass three times the size of the normal gland. The gall bladder was distended and contained stones. Cholecystectomy was done, the pancreas incised and drained and the abdomen closed. The urine obtained after operation contained 200 units of diastase the next day 100 units and a little sugar 3 weeks later 10 units and no sugar. The recovery was uneventful. The case was considered as in the pre-hemorrhagic stage of acute pancreatitis.

Cope cited a case with marked left shoulder pain.

CASE 13. A female, aged 60 years, with previous ill defined gastric symptoms complained of sudden severe abdominal pain more marked in the left epigastrium also a pain in the left shoulder. Pressure on the abdomen over the pancreas increased the shoulder pain. At operation gall stones and a large swollen pancreas, brown effusion, and fat necrosis

were found. Cholecystectomy with drainage of pancreas was done, with complete recovery. Shoulder pain was not present after operation.

Starling reported several cases of recurrent subacute necrosis of the pancreas two of which however, on analysis showed no necrosis and seemed to be really cases of acute interstitial pancreatitis.

CASE 14. A male, aged 67 years, had attacks in 1920, 1923 and 1932 diagnosed intestinal obstruction but with transient glycosuria. Present attack, 3 weeks before admission, was severe with acute epigastric pain and transient glycosuria, but which gradually improved. A few weeks later he developed acute urinary obstruction and died. Autopsy showed a thick gall bladder containing stones, generalized fat necrosis, a pancreas large and hard, but showing normal cellular structure on section.

CASE 15. A male aged 30 years, had had several acute attacks for the past several years of epigastric pain radiating to the back lasting a few to 48 hours with complete freedom between attacks. Present attack was severe the patient appeared toxic white blood cells 18,000 and abdomen tremendously distended. Operation 2 days after onset of the attack showed a distended gall bladder no fat necrosis, pancreas greatly enlarged and hard. The abdomen was drained, but death occurred the same night. There was no autopsy.

Love reviewing 51 cases of acute pancreatitis treated at the London Hospital during 1911 to 1924 made no special mention of the type of lesion found but described 1 case in which a swollen and oedematous pancreas was found at operation.

CASE 16. A male, aged 53 years, had two severe attacks of abdominal pain, 24 and 17 years ago, which abated spontaneously. The first one had been diagnosed acute alcoholic gastritis. The present or third seizure was no severe that the patient became unconscious. On admission he was in shock cyanotic. Operation revealed general fat necrosis, a swollen and oedematous pancreas and a distended gall bladder. Cholecystotomy was performed. No stones were present. Recovery followed. Six months later he was seized with a fourth attack, was admitted moribund, and died shortly afterward.

Quick in a review of 49 cases of acute pancreatitis in Australia and New Zealand, stated that 9 of them (18.4 per cent) showed only an oedema of the pancreas manifest as a glassy swelling of the subperitoneal tissues over the pancreas and its immediate neighborhood." He noted also that the oedema may be distinctly bile stained and that "minor evi-

dences of fat necrosis are not uncommonly found. Quick discussed its differentiation from the ordinary hemorrhagic type of pancreatitis and claimed it had been possible in his cases and that its recognition as a definite clinical entity was of some importance. Against its being merely an early stage of acute necrosis was the fact that there was no essential difference in the duration of the disease, in a few cases cited, between those with oedema and those with actual necrosis.

The French literature on acute diseases of the pancreas was summarized in 1926 in the monograph by Brocq who discussed 'acute oedematous pancreatitis' in a separate chapter but considered it as a relatively rare form of pancreatitis. He was able to collect but 9 cases, 4 of them by Zoepffel (mentioned above) and 5 which he reported for the first time. The instance described above by Mercadé was not included. It is of considerable interest, however that since Brocq's monograph more than 15 additional cases have been described in French journals 6 of them presented by Brocq himself at a meeting of the French National Society of Surgery in 1932. Of these 6 cases, all of which were operated on by various surgeons, 2 were described elsewhere by Gautier and will be mentioned later on. Of the 4 remaining 1 has not been considered since the pancreas was not actually examined. The 3 remaining cases may be summarized as follows:

CASE 17. A patient of M. Brucens, Chinese female, aged 18 years, with no previous illness was suddenly seized with epigastric pain one-half hour after eating and followed by vomiting. It recurred more severely the following day and she was given opium. When seen she had pulse of 80, temperature 36.5 degrees C. she was prostrated, the abdomen was generally tender the epigastrium tense and contracted. A diagnosis of perforated ulcer was made but the patient refused operation. The next day the pain had disappeared. Several days later an X-ray series of the gastro-intestinal tract showed a persistent notch in the lesser curvature. One week later there was a recurrence of severe pain. Operation the same afternoon showed a little serous peritoneal fluid, but nothing abnormal in the stomach, pylorus, or duodenum. The gall bladder was distended with bile, no calculi were felt in the cystic or common duct. When the pancreas was exposed some clear fluid and fibrin escaped, the peritoneum over the gland was turgid and infiltrated with a gelatinous

edema. No hemorrhage or fat necrosis was seen. The pancreas was drained and the appendix removed. Death occurred the following day.

CASE 18. A patient of M. Vergos, male Arab, aged 40 years, with negative past history was suddenly taken with lancinating epigastric pain. On examination his abdomen was found to be soft except for tenderness and rigidity over the umbilicus. Diagnosis was made of perforated ulcer or acute pancreatitis. Operation performed 8 hours after onset of attack, showed a pancreas which was hard, but surrounded by a yellowish edema which extended into the mesocolon and small omentum. The edema took the form of blisters over the surface of the pancreas. Drainage of the lesser sac was performed. The gall bladder was adherent to the right colic flexure but the walls were soft and contained no stones. The common duct felt normal. Recovery was complicated by attacks of acute prostration treated effectively with insulin but was eventually complete.

CASE 19. A patient of V. Baturcann and G. Chi pail de Jassy of Rumania, a male, aged 37 years, had had gastric symptoms for 4 years, with no relation to meals, was suddenly seized, one half hour after drinking coffee with violent epigastric pain, radiating to the back, and followed by a sense of impending death. On examination the patient appeared in extremis; temperature was 36.6 degrees C, pulse, irregular about 100 per minute, there was generalized abdominal tenderness and epigastric rigidity. The urine showed a trace of sugar. Diagnosis perforated ulcer or acute pancreatitis. Five hours after onset operation was done and revealed a slight amount of serosanguineous peritoneal fluid and a distended gall bladder in which after emptying, a few small calculi could be felt. The gastrophatic omentum and the liver hilus were the site of a greenish edema which extended to the duodenum. The pancreas too was covered with a marked greenish edema especially at the head. There were some subperitoneal hemorrhages. Capsule was opened and drained and the gall bladder removed. Recovery was uneventful.

Leveuf discussed the question of the edematous pancreas at some length and presented 2 cases of his own. Since 1 of them showed definite necrosis at autopsy it has not been included in this survey. The other case is summarized as follows:

CASE 20. A male aged 28 years, had had vague abdominal pains for 2 months, but the day before admission he was suddenly seized by an intense pain in the epigastrium which gave the sensation of a band. He vomited. Examination showed pain on pressure under the right costal margin with radiation to both lumbar regions. Under a diagnosis of perforated duodenal ulcer he was operated on 4 hours after the onset of the pain. The peritoneum

was clear the mesentery especially the mesocolon was edematous as was the pancreas which was of a grey greenish color and gave the impression of necrosis. No hemorrhage was seen and no lesion of biliary tract was apparent to palpation. The pancreas was drained with an uneventful recovery.

During the past few years many other cases have been described in the French literature either as cases of acute pancreatitis or specifically as edematous pancreatitis. The following 13 instances represent such isolated reports. (The temperatures, when recorded in these cases, are in degrees, Centigrade.)

CASE 21. Reported by Gouverneur. A male, aged 34 years, 24 hours before admission had severe abdominal pain and vomiting. Examination revealed temperature 37.5 degrees, pulse, 90, abdomen not distended, but tender and rigid, especially in the mid and left epigastrium. Diagnosis of intestinal obstruction was made. Operation performed 36 hours after the onset of the attack, showed abundant serosanguineous fluid in the abdomen, stomach and gall bladder appeared and felt normal, tiny areas of fat necrosis in mesocolon, and the pancreas a little large, edematous, and hard. A drain was placed into the lesser cavity through the gastrophatic ligament and the abdomen was closed. For 3 days the course was good, but in the night of the fourth day he developed profound intoxication with vomiting, dyspnea, cyanosis, and died.

CASE 22. Reported by Moulouquet. A male, aged 29 years, previously entirely well had a sudden severe abdominal pain 5 weeks before entrance and was taken to the Hôpital Saint Louis where his temperature ranged around 40 degrees. After several days observation he was discharged but was then observed for several weeks at the Hôpital Andral where he had an oscillating fever 37 to 39 degrees and some abdominal pain and distention and a tumefaction was felt in the epigastrium. An abscess of the liver was suspected. At operation, 6 weeks after onset the peritoneum was found to be clear the liver normal, the gall bladder soft and not distended, no stones were felt, the pancreas was enlarged and of a rich rose color, smooth and edematous. Repeated needle punctures were carefully done but no pus could be found. The abdomen was closed around a drain through the lesser omentum. The temperature fell the next day rose again in a week and remained normal after 1 month. Persistent abdominal distention was a feature of his course even on discharge 2 months later. Diarrhea was present for several days. Follow-up after discharge was unsuccessful.

CASE 23. Reported by Tuffier. A male aged 48 years had had several attacks of biliary colic in the past few years. Between attacks he had mild dyspepsia for a time but later felt quite well. The night before admission he was awakened with a severe pain

similar to a biliary colic in the right hypochondrium, but which took the form of an epigastric band. Morphia scarcely affected the intensity of the pain. There was tenderness in the epigastrium. The pulse was almost uncountable. Operation was delayed because the patient was considered moribund. Fluids, adrenalin, and caffeine were given and on the second day he was operated on. Clear fluid escaped from in front of the pancreas which was enlarged, oedematous, and tinged a light violet cast. The gall bladder was not distended but in the neck a little gravel was felt. The abdomen was closed with drainage. Recovery was rapid and the patient was discharged in 2 weeks. Two weeks after this he re-entered and the gall bladder containing many stones was removed. The pancreas this time presented three indurated areas and the head of the gland was harder than normal.

CASE 24. Reported by Bartholemey. A woman, aged 42 years, suffered in the past from attacks of "hepatic colic," but the night before admission to the hospital, after a full meal, she was suddenly seized with severe general abdominal pain for which a physician injected morphia. The next day the pain was worse and she vomited. The pain became agonizing and located around the umbilicus. The abdominal distention made examination for local tenderness impossible. At operation, performed at once, no perforation of the intestines was made out, the gall bladder on exploration revealed no stones, the pancreas was swollen, congested and bluish, without focal lesion. The abdomen was closed with a small drain to the peritoneum. Recovery was uneventful. The patient remained well (2 years).

CASE 25. Reported by Desplaces and Ebrard. A young woman, age not stated, 18 months after the birth of her first child, began having attacks of pain similar to the present one which occurred every 2 or 3 months, but had been gradually becoming more frequent. The pain was excruciating and radiated to the chest and right shoulder and was followed by vomiting. One attack lasted 4 days and was followed by jaundice. The present attack was severe, in the epigastrium, but radiated to the back and associated with immediate prostration and vomiting. On admission a few hours later pulse and temperature were normal, abdomen was slightly distended, no muscle spasm but excessive tenderness above the umbilicus and over the gall-bladder area. Operation 12 hours after onset of attack revealed a large gall bladder adherent, full of stones, duodenum adherent under the liver the pancreas large and infiltrated with oedema which extended into the retroperitoneal tissue and involved the mesocolon and surrounding area. It looked as if fluid had been injected, such as novocain in operations under local anesthesia. There seemed to be some foci of destruction, however but there was no fat necrosis and only a small amount of serosanguineous fluid. The pancreas was incised and drained. Recovery was uneventful. One month later a cholecystectomy was done and there was merely a slight induration at head of pancreas.

CASE 26. Reported by Brinn. A female, aged 61 years, in the past had been troubled with abdominal pain which her physician had called "biliary colic." The present attack began 5 days before admission with extreme epigastric pain accompanied by vomiting and followed by marked prostration. The family physician had diagnosed intestinal obstruction. On examination the patient appeared very ill pulse 130 temperature, 37.8 degrees the abdomen, diffusely distended and somewhat tender with no localizing signs. Operation at once revealed rose-colored fluid in the peritoneum, dilated bowel and in the omentum areas of white fat necrosis, oedema of the pancreas which was of a wine red color. The liver appeared sclerotic, the gall bladder greyish, and no stones were made out. The peritoneum over the pancreas was split and drained, a cerclage was done, and the wound was closed. Recovery was uneventful and patient was able to take up her former occupation as a maid.

CASE 27. Reported by Gautier. A female, aged 48 years, who had had vague digestive symptoms in the past, was suddenly taken with severe abdominal pain radiating to the right shoulder but which disappeared in a few hours. The next day a much more severe attack occurred followed by profound prostration. On examination a transverse tumefaction was felt deeply in the epigastrium which, on pressure elicited deep groans from the moribund patient the rest of the abdomen was negative to palpation. Operation 16 hours after the onset of the attack, showed oedema of the omentum, a pale pancreas, the peritoneum covering it turgid with oedema. It was incised and the pancreas drained. The biliary tract revealed nothing abnormal. Immediate recovery was good, but on the third day the patient died suddenly.

CASE 28. Also reported by Gautier. A female, aged 38 years, who several years in the past had paratyphoid fever 1 year ago had an attack of severe indigestion followed by jaundice, with complete recovery. Suddenly one night she was awakened with sudden violent abdominal pain which soon became critical. On examination a zone of marked muscle spasm about the size of the palm of one's hand was made out to the left and a little above the umbilicus. Operation 9 hours after onset revealed no peritoneal fluid, nothing abnormal about the stomach, duodenum, liver gall bladder and spleen. The pancreas was pale and oedematous. The peritoneum covering the gland was incised and drained drainage consisted of serosanguineous fluid which after a few days, seemed to irritate the wound margin. It ceased in a week, however and the patient left the hospital on the twentieth day and had no further symptoms (6 months later).

CASE 29. Reported by Okinczyk. A female, aged 42 years, well except for a heavy feeling in the epigastrium for the past 8 days, on the morning of admission, one-half hour after breakfast, was suddenly seized with violent pain in the epigastrium which continued in the form of cramps, radiated to the

back and was followed in an hour by vomiting. On examination she showed a transverse resistance in the epigastrium and cutaneous hyperaesthesia, pulse 80 temperature, 36.8 degrees. A diagnosis of perforated ulcer was made and operation performed 4 hours after onset of attack. Free blood was encountered when the abdomen was opened, the liver and spleen were normal, the gall bladder was tensely filled with bile no stone was felt in the cystic duct or in the common duct. The pancreas was enlarged whitish oedematous so as to be translucent. Its capsule was torn and some blood escaped and a drain was packed into the wound. No trace of fat necrosis was noted. The gall bladder was drained through a separate stab wound. There were no stones in the lumen. Recovery was uneventful and patient has remained well.

CASE 30. Described by Guilbello. A male, aged 23 years had mild attacks of vague abdominal pain for 12 days, but had otherwise been perfectly well until the present attack of severe epigastric pain which began 3 hours after dinner the previous day and continued until he was admitted to the hospital. Examination revealed a rigid abdomen, normal pulse and temperature. Diagnosis of perforated ulcer was made and operation, performed 12 hours after onset of attack showed yellowish peritoneal fluid, negative stomach and duodenum a marked oedema of the lesser omentum and part of the gastrocolic omentum, and no ulcer on the posterior surface of the stomach. The pancreas, however was the site of a tremendous yellowish oedema. The prepancreatic peritoneum was opened and the pancreas itself seemed harder than normal. The gall bladder though normal looking was distended with bile. Palpation revealed no stone in the biliary tract. Drainage of the pancreas was done. On awakening from the anesthetic the patient stated his abdominal pain was entirely gone. Recovery was uneventful.

CASE 31. Reported by Razemon and Lambret. A male aged 31 years had suffered from time to time during 1 year with cramps in his abdomen after eating. The evening before admission, however he was suddenly seized, 3 hours after eating with violent epigastric pain which radiated to his back and was followed by continued vomiting. On examination it was found that the patient was obviously in extreme pain the pulse was 100 temperature, 38.8 degrees abdomen slightly distended with marked tenderness over epigastrium and right hypochondrium associated with muscle spasm. A diagnosis of perforated ulcer was made and operation, performed 7 hours after onset of attack, disclosed some serous fluid in the peritoneum oedema of the duodenal mesentery especially of the second portion, but no ulcer and oedema of the mesocolon which contained extravasated blood over a small area. The pancreas was much enlarged and oedematous. No fat necrosis was seen. The gall bladder was not tense, felt normal and without stones. The pancreas was drained and the wound closed. After the first

36 hours the postoperative course was uneventful. When seen a month later he complained only of a feeling of weight in the epigastrium after meals. X ray examination showed evidence of an ulcer of the lesser curvature.

CASE 32. Reported by Chifolian. A male, aged 40 years, previously entirely well, was suddenly stricken one morning with acute epigastric pain which later became so severe as to provoke respiratory distress. On examination it was found that the patient had a pulse of 100 and temperature of 37.5 degrees generalized abdominal rigidity and hyperaesthesia most marked at the pit of the epigastrium and the right hypochondrium. Diagnosis perforated ulcer. At operation 24 hours after onset of attack no ulcer was found. A greenish colored oedema had infiltrated the lesser omentum and the transverse mesocolon, but was especially marked in the head of the pancreas whose lobules appeared as a mass of gelatin and was continuous with the concavity of the duodenum. The rest of the pancreas was swollen and on palpation was harder than normal. The gall bladder was attached to the duodenum and its wall was inflamed at this point. No stones were felt by palpation of the cystic duct and common duct. The pancreas was drained and the wound was closed. Recovery was uneventful. Before discharge X ray of the stomach after barium meal showed nothing of importance cholecystogram after ingestion of 'Ictalodo' was negative.

CASE 33. Reported by Ferey. A female aged 71 years with negative past history was suddenly awakened with severe epigastric pain radiating to both sides of the chest. On examination patient was found to be in extreme pain epigastrium tense and tender in contrast to the softness below the umbilicus. Diagnosis of perforated ulcer or gall bladder was made. Operation was performed 21 hours after onset of attack and showed evidence of fat necrosis the lesser omentum thick and infiltrated with a greenish oedema, and the head of the pancreas tremendously enlarged, red, turgid, and oedematous. Its surface was drained without incision. The gall bladder was tense as if ready to burst it was opened and drained but no stones were present. None was felt in the common duct. Recovery was rapid and uneventful.

CHRONIC PANCREATITIS

Since many authors have claimed that chronic pancreatitis is caused by repeated attacks of acute subsiding pancreatitis, mention should be made of several cases described by Mayo-Robson and Moynihan. Though operated on for relief of chronic jaundice a swollen pancreas causing pressure on the lower end of the common duct was found in all of these patients. At operation the gall bladder was drained following which the jaundice disappeared the fistula finally closed and pa-

tients remained well long enough to exclude the diagnosis of carcinoma, although biopsy was not done in any. Of particular interest is the history in all of them of repeated attacks of epigastric pain which although called biliary colic, may actually have been attacks of acute interstitial pancreatitis. The anatomical findings were not conclusive for even though no stones were found they may have been present and passed before operation.

Thus in one case there were no stones found in the gall bladder or common duct though the viscous was obviously the site of chronic inflammation. In another case the painful attacks were described in the pit of the stomach ending in vomiting. Here, too, no stones were found in the biliary tract though the gall bladder was adherent and slightly distended. In the next case the patient had attacks resembling those of gall stones. This patient did have many stones in the gall bladder and common duct, but the large nodular head of the pancreas was "partly obstructing the common duct." In another case the patient had had recurring attacks of cramp in the stomach. At operation a healthy normal gall bladder was found and a hard irregular mass in the head of the pancreas. Nothing was done except relief of extensive adhesions binding the pylorus to the liver. Recovery nevertheless, was uneventful and the patient became entirely free of symptoms. In still another case the patient had attacks of spasm in the upper abdominal region for 12 years, and at examination had a point of tenderness in the midline one and one-half inches above the umbilicus. At operation a thickened gall bladder was seen, but it contained no stones nor did the common duct. The lower end of the choledochus was surrounded and overlaid by a well marked swelling of the pancreas which was harder than usual. Cholecystotomy was performed, recovery was uneventful, and the patient remained well (3 years). In another case the patient had numerous seizures of what appeared to be biliary colic. At operation, though the gall bladder was contracted and surrounded by numerous adhesions, exploration revealed no stones. The head of the pancreas was enlarged and very firm. A similar case reported by C. L. Gibson¹ was cited where a biopsy of the pancreas was done and showed "interstitial pancreatitis." One can find other reports of chronic pancreatitis where there has been a history of attacks of severe epigastric pains in which a swollen, hard pancreas is found at operation. Thus, Jennings reported a case of chronic pancreatitis which is probably one whereby repeated attacks of acute edema occurred. The patient, a 38 year old male, had an attack of mid-epigastric pain radiating to back and lower ribs lasting several hours another attack 1 year ago and then repeated periods of indigestion

and occasional slight jaundice. Four days before admission he had nausea and vomiting with sharp epigastric pain and backache. He showed on examination a slight jaundice, epigastric tenderness, and a moderate right sided rigidity. At operation the gall bladder was found to be thickened, but contained no stones nor did the common duct which was dilated. The pancreas was stony hard. Cholecystectomy was done and the common duct drained (for 100 days) with recovery.

Usually these attacks are assumed to be of gall stone origin and doubtless many of them are thus to be explained. On the other hand the gall bladder is in many cases free of obvious disease excluding it as the probable cause of the seizures. It might be of some value to analyze further histories of such cases for there are a great many on record. They are mentioned in this paper merely to suggest that acute subsiding pancreatitis may be the explanation of the previous attacks in cases operated on for biliary disease in which a hard pancreas is often noted as a subsidiary finding.

PRESENTATION OF AUTHOR'S CASES

Protocols of the 4 cases seen in this clinic are really self explanatory. In 3 of them microscopic section of the pancreas was possible one at autopsy and two through biopsy at operation. The section of one of these, though from the surface of the pancreas, unfortunately did not show pancreatic acini but only areas of fat necrosis surrounded however by acute inflammation. In the 2 others definite infiltration with polymorphonuclear cells can be seen yet no necrosis was present, the normal acinar structure remaining intact (Figs. 1, 2 and 3).

In one of the patients (Case 34) the diagnosis rested largely on the marked increase in the blood amylase at the height of an attack. The value of 50 units was ten times the normal level and had been found before only in cases of pancreatic cyst and acute pancreatic necrosis (14). It returned to normal after the attack and remained so. Since the operation was performed 2 months after the last attack (for the removal of a gall bladder containing gall stones) we did not expect to find any anatomical changes in the pancreas and, indeed the gland felt and looked normal. A biopsy was, therefore, not done.

CASE 34 V. H. a 21 year old housewife had beginning 17 months before her first visit several attacks of severe pain in the right upper quadrant radiating to the back, associated with vomiting and once severe enough to require morphia. Her doctor told her he found sugar in her urine on one occasion. The attacks would usually subside in a few hours. She became pregnant and was well until the seventh month when several attacks occurred only to subside. Following the birth of a healthy baby the attacks became more frequent and severe and were especially apt to come after a heavy meal so that, to avoid them, she starved and lost 30 pounds. Jaundice was never observed. A gastro-intestinal X ray series was negative. oral cholecystogram showed a normally visualized gall bladder. She was treated conservatively for 5 months, but attacks still continued and now usually were accompanied by loose bowel movements. The possibility that these attacks were due to pancreatitis occurred to Dr. Duden who referred the patient to the present author. A blood amylase was taken several days after an attack and showed a definite though slight elevation (10 units, normal, 5). She was urged to come in the hospital for observation during an acute attack which she did (September 11, 1932). There was epigastric tenderness at this time and not much else. Blood taken however, showed a very high amylase content (50 units). The attack was mild and she was not kept in the hospital. A few days later following an intravenous cholecystographic examination the gall bladder was clearly visualized again but it now showed multiple negative shadows unmistakably due to stones. She had no further attacks, and at operation on October 16, 1932 her appendix and a gall bladder containing many stones were removed. The pancreas by inspection and palpation seemed normal. Recovery was uneventful. Blood amylase normal.

CASE 35 A. M. M. a 54 year old housewife had had for 10 years attacks of severe sudden pain in pit of stomach radiating only to the back, lasting usually about 4 hours, often following meals and accompanied by nausea and vomiting. Intervals between attacks varied from several days to several weeks. No jaundice was noticed. On examination (1926) she had slight tenderness in both upper quadrants, greatest on the left. Cholecystogram showed non-visualization. Other examinations were negative. Operation several days following last attack showed a thickened gall bladder containing one large stone, a common duct which was also thickened a little dilated but in which no stones were felt. Areas of fat necrosis in the omentum and a thickened pancreas in whose capsule were many white deposits of fat necrosis. Biopsy of these areas on section showed merely foci of fat necrosis surrounded by acute cellular infiltration (Fig. 1). Cholecystectomy was followed by an uneventful recovery. For 2 years after operation she had a number of the old attacks described as gall-stone colic often requiring morphia. These grew less severe and she has had none in the past 3 years (1932).



Fig. 1 Case 35 Low power photomicrograph showing fat necrosis, F.N. surrounded by an acute inflammatory infiltration. Patient had an acute attack several days before operation. Biopsy taken from capsule of pancreas.

CASE 36 L. H. W. a 48 year old female had been troubled with severe attacks of pain in the upper right quadrant for 16 years radiating to the right side and right scapula. She was jaundiced during one attack 5 years ago. The present attack started 5 days before admission and has required morphia since onset. Examination showed tenderness over the right upper quadrant. White blood cell count 11,800 normal pulse and temperature. Operation 3 days after admission revealed a thickened gall bladder containing several small stones. The pancreas was exceedingly hard and firm a piece was removed for biopsy. Cholecystectomy was done common duct explored found patent and drained. Recovery was uneventful. Microscopic study of gall bladder showed only chronic inflammation, the pancreas, however besides diffuse fibrosis, showed marked acute inflammation as shown by infiltration of polymorphonuclear leucocytes and also small round and plasma cells (Fig. 2). Attempts to determine the further history of this case were unsuccessful.

CASE 37 L. E. a 25 year old negro previously well was admitted to the St. Louis City Hospital complaining of cramp-like pains in the stomach of 2 days duration vomiting and no bowel movement for 3 days. On examination he was found to have general abdominal distention with tenderness and muscle spasm over the umbilicus and mid-epigastrium white blood cells 18,000 pulse 96 temperature 98 degrees F. Plain X ray plate of the abdomen showed some dilated bowel suggestive of intestinal obstruction. Repeated enemata were ineffectual. Diagnosis of intestinal obstruction was made and operation started under spinal anesthesia. A beef broth fluid was present in the peritoneal cavity. Collapse occurred and the patient died on the table. Exploration revealed no obstruction a normal gall bladder but a tremendously enlarged beefy red

pancreas with fat necrosis in its capsule. It was removed for study. It cut hard, but no areas of hemorrhage or softening were made out. Several blocks were cut for microscopic examination and showed too, no evidence of cellular necrosis, but merely acute inflammation as shown by marked infiltration with leucocytes and fluid (Fig. 3).

DEDUCTIONS

The clinical reports herein presented offer sufficient evidence. It is believed to justify the conclusion that we are dealing with a type of acute pancreatitis with edema, swelling or induration which is distinct from the usual cases of acute pancreatitis in showing no evidence of gland necrosis, hemorrhage, or suppuration. Although the anatomical data depended in large part on palpation and inspection at operation, microscopic examination of the pancreas in 6 cases (3 of them our own) have yielded objective evidence that we are dealing with an acute inflammatory lesion of the interstitial tissue of the pancreas in which hemorrhage or necrosis play no part. That these cases represent a definite pathological entity, and are not merely an early stage in the development of frank pancreatic necrosis seems apparent from considerations mentioned below in the discussion of its pathogenesis.

It is believed, moreover, that these cases represent a clinical as well as a pathological entity. For purposes of such an analysis the important clinical features of the collected cases are hereby discussed. A brief summary of some of this data is also presented in the accompanying Table.

ANALYSIS OF IMPORTANT CLINICAL FEATURES

History of previous attacks was present in 24 of the 38 cases for periods varying from a few weeks to a number of years. Many of the patients had complete relief of symptoms between attacks which often were only of a few hours' duration. It is difficult to evaluate the nature of these attacks since most of them were merely described as biliary or "hepatic colic." In Archibald's case the evidence is clear though that they were definitely of pancreatic origin and not biliary at all. Moreover, McWhorter points out very significantly in regard to the history of previous attacks in his cases that 21 showed no lesion of the gall

bladder 17 at operation and 4 at autopsy and that unless a previous lesion of the gall bladder can heal without leaving a trace the previous attacks must have been due, not to biliary colic, but to mild attacks of pancreatitis. To illustrate the possibility of error in accepting a history of biliary colic as actually being of biliary origin is the case reported by Amadon who operated on a patient and found after a thorough search complete absence of a gall bladder. The head and body of the pancreas were irregular and indurated. Yet the patient had complained of dyspepsia and attacks of upper abdominal pain located beneath the right rib margin and right scapula. These symptoms of pain must have been referred from the head of the pancreas. A case similar to this in every detail was operated on at Barnes Hospital several years ago.

Clinical signs and symptoms Pain was the predominant and universal symptom. Its severity was so great that prostration was present in many cases, but in only a few was it accompanied by the signs of shock so often seen in the development of acute pancreatic necrosis. In nearly half of the cases (13 of 30 in which the interval was mentioned) the attack was apparently so severe that operation was performed within 24 hours, in 8 of the 13 cases with the diagnosis of perforated ulcer which may perhaps give us a clue as to the nature of the pain. On the other hand, in those operated on for intestinal obstruction (6 cases) the duration before operation was 24 hours or over which suggests that the pain was intermittent and colic like in character which, indeed, was specifically mentioned in many of the protocols. Distention also was often present in these patients (7 cases).

The location of the abdominal pain and tenderness was sometimes general otherwise nearly always in the epigastrium (27 cases). Radiation was mentioned in only 19 cases but was to the back in 13 of them. In 3 cases radiation was to the right and in 2 cases to the left side and in 2 the patient complained of a sensation of an epigastric band. In Cases 10, 13 and 30 disappearance of the pain was noted immediately after operation in which the swollen pancreas was incised. In the first 2 definite radiation to the left had been ob-



Fig. 2. Case 36. Low power photomicrograph of biopsy of pancreas removed at operation several days after onset of acute symptoms showing intact acini and infiltration with leucocytes. Inset shows under high power many polymorphonuclear leucocytes in the interacinar tissue.



Fig. 3. Case 37. Low power photomicrograph from pancreas section removed 2 days after onset of acute attack showing extensive leucocytic infiltration between the lobules as well as the acini which are everywhere intact. Inset shows under high power many polymorphonuclear leucocytes between the acini.

served in the third no mention was made of radiation.

Local tenderness, when elicited was found in nearly every case in the mid-epigastrium but in 8 cases was found also on the left side and in an equal number over the right upper quadrant. In a few cases a definite area of transverse tenderness in the epigastrium was made out with a suggestion of an associated tumefaction. Glycosuria was noted in 6 cases of the present series always during or after the attack, usually in small amounts but in Case 11 was present for 12 days following operation attaining a value of 0.7 per cent. This finding indicates of course involvement, possibly by pressure alone of the islets from the inflammatory changes in the acini. When detected it immediately attracts attention to the pancreas. It may have been present in these cases more frequently if searched for repeatedly.

Enzyme studies were made in 3 cases of the present series. In 1 of them the diagnosis was based on a marked increase in the amylase of the blood. In the 2 other cases the lipase and diastase of the urine was studied and in each a definite increase noted which returned to normal after the disease subsided. Doubtless deviations from the normal would have been noted in many other cases had they been searched for.

Anatomical findings. In nearly all cases more or less definite evidence of oedema was found either of the pancreas itself or of the peritoneum overlying it. In some it was rather extensive spreading into the mesocolon and adjacent duodenum. The parenchyma of pancreas in spite of the oedema felt on palpation sometimes indurated and hard sometimes merely more swollen than normal sometimes both swollen and hard. The oedema in a number of instances was described as yellowish or greenish suggesting the presence of bile. While these gross findings at operation give only suggestive information as to the nature of the lesion, microscopic studies in 6 cases showed intact cellular structure without any evidence of necrosis of the gland. The striking finding was the marked infiltration of acute (polymorphonuclear) inflammatory cells into the interstitial tissue between lobules as well as acini often with evidence of oedema as shown by the outpouring of fluid. Two of these cases (Nos. 3 and 6) were reported by Zoepfel and were from biopsies at operation. Another was from an autopsy specimen (Case 14) in which the patient died from another cause some weeks after the attack. The 3 remaining instances are from the cases observed in this clinic and photomicrographs are reproduced (Figs. 1, 2, and 3). It is interesting

TABLE I—MAIN CLINICAL FINDINGS IN 37

| Case | Author | Age and sex | Previous attacks | Radiation of pain | Abdominal tenderness or distention | Interval before operation | F + leucocytes | Glyco-suria |
|------|---------------|-------------|------------------|---------------------|------------------------------------|---------------------------|----------------|-------------|
| | Isaacs | M | ? | ? | Distention | ? | Yes | — |
| | Mercader | 30 F | None | ? | Distention | 4 hr | Yes | — |
| 1 | Zorpfel | 45 F | 3 yrs | | Epigastrium | 4 hr | Yes | + |
| 2 | Zorpfel | 40 M | whs | ? | Mid- and right epigastrium | 24 hr | Yes | — |
| 3 | Zorpfel | 5 M | 9 mos | ? | Right and left epigastrium | day | No | — |
| 4 | Zorpfel | 47 F | Yes | Back | Epigastrium and right side | hr | N | — |
| 7 | Grass | 31 F | 8 yrs | ? | Epigastrium and left side | 3 days | Yes | — |
| 8 | Archibald | 65 M | yr | Back and shoulders | Epigastrium and left side | days | No | — |
| | Lozier | 52 F | yr | Back and shoulders | Epigastrium and left side | days | Yes | — |
| 10 | Buchter | 46 M | None | Back and left side | Epigastrium | 4 days | N | — |
| | Staction | 30 M | yr | Back and right side | Epigastrium | ks | No | + |
| | Refrance | 44 F | ? | Back | Epigastrium | day | Yes | + |
| | Cope | 60 F | 1 year | Left shoulder | Left epigastrium | ? | Yes | — |
| | Starling | 67 M | Yes | ? | Epigastrium | | Yes | + |
| 5 | Starling | 30 M | Yes | Back | Distention | 48 hr | No | — |
| 6 | Love | 33 M | Yes | ? | ? | 7 hr | No | — |
| | Brocq | 28 F | Yes | | Epigastrium | 8 hr | Yes | — |
| 8 | Brocq | 40 M | N | ? | Epigastrium | 8 hr | No | — |
| 9 | Brocq | 56 M | yr | Back | Epigastrium | 3 hr | No | + |
| 10 | Leverf | 46 M | 1 year | Epigastric band | Right epigastrium | 4 hr | No | — |
| | Gusterson | 34 M | N | ? | Mid- and right epigastrium | 26 hr | Yes | — |
| | Martlingqvist | 40 M | Yes | ? | Distention | 7 ks | No | — |
| 13 | Tufar | 48 M | Yes | Epigastric band | Epigastrium | 48 hr | ? | — |
| 14 | Buchthorn | 44 F | Yes | ? | Distention | hr | ? | — |
| | Duplex | F | Yes | Back and right side | Umbilicus and right side | hr | No | — |
| 16 | Brown | 5 F | Yes | ? | Distention | 3 days | Yes | — |
| 17 | Gastner | 48 F | 1 year | Right shoulder | Epigastrium | 16 hr | No | — |
| 18 | Gastner | 30 F | Yes | ? | Mid- and left epigastrium | 9 hr | No | — |
| 19 | Olney | 42 F | No | Back | Epigastrium | hr | No | — |
| 20 | Owenbello | 3 M | 1 year | | General rigidity | hr | No | — |
| 21 | Rasmussen | M | Yes | Back | Mid- and right epigastrium | 7 hr | No | — |
| 22 | Chafetz | 40 M | N | | Mid- and right epigastrium | 24 hr | No | — |
| 23 | Ferry | 7 F | No | Chest | Epigastrium | hr | Yes | — |
| 24 | Ellman | F | Yes | Back | Epigastrium | | No | + |
| 25 | Ellman | F | Yes | Back | Right and left epigastrium | 7 days | Yes | — |
| 26 | Ellman | 9 F | Yes | Right shoulder | Right epigastrium | 8 days | No | — |
| 27 | Flann | M | No | ? | Distention | days | Yes | — |

to note that in one of these (Fig. 2) the acute inflammatory changes shown on section were a surprising finding for at operation the gland was hard and indurated which suggested carcinoma and was, in fact the reason a biopsy was performed. Since the gall bladder in this

case showed only chronic changes it seems not unlikely that the acute symptoms present for several days before operation were in fact, due to the acute inflammation in the pancreas.

The biliary tract was mentioned in 35 cases and in 16 of them the gall bladder was re-

CASES OF ACUTE INTERSTITIAL PANCREATITIS

| Pre operati diagnosis | Biliary tract | Treatment | Outcome | Remarks |
|-------------------------|---------------|------------------------------|----------|------------------------------------|
| Intestinal obstruction | ? | Laparotomy only | Recovery | |
| I ntestinal obstruction | ? | Drainage of pancreas | Recovery | |
| ? | Gall stones | Cholecystectomy cholecho- | Recovery | Biopsy of pancreas |
| Cholecystitis | Gall stones | stomy and drainage of | Recovery | |
| Cholecystitis | Gall stones | pancreas | Recovery | |
| Cholecystitis | Gall stones | | Recovery | Biopsy of pancreas |
| Cholecystitis | Gall stones | Drainage GB and P | Recovery | |
| Appendicitis | Normal | Appendectomy | Recovery | Increased hspase in urine |
| ? | Gall stones | Cholecystectomy | Recovery | |
| ? | Thick GB | Drainage of P | Recovery | |
| Duodenal ulcer | Normal | Drainage of P | Recovery | |
| Perforated ulcer | Gall stones | Cholecystectomy and drainage | Recovery | Increased diastase in urine |
| ? | Gall stones | of P | Recovery | |
| Intestinal obstruction | Gall stones | None | Death | Several weeks after attack Autopsy |
| ? | Dilated GB | Simple drainage | Death | Same night of operation |
| Acute pancreatitis | Dilated GB | Cholecystectomy | Recovery | |
| Duodenal ulcer | Dilated GB | Drainage of P | Death | In 23 hours |
| Perforated ulcer | Adherent GB | Drainage of P | Recovery | |
| Perforated ulcer | Gall stones | Drainage of P | Recovery | Gall bladder also removed |
| Perforated ulcer | Normal | Drainage of P | Recovery | |
| Intestinal obstruction | Normal | Drainage of P | Death | In 3 days |
| Liver abscess | Normal | Drainage of P | Recovery | |
| Perforated GB | Gravel in GB | Drainage of P | Recovery | |
| ? | Normal | Simple drainage | Recovery | |
| ? | Gall stones | Drainage of P | Recovery | |
| Intestinal obstruction | Normal | Drainage of P | Recovery | Cecostomy also done |
| Acute pancreatitis | Normal | Drainage of P | Death | In 3 days |
| Acute pancreatitis | Normal | Drainage of P | Recovery | |
| Perforated ulcer | Dilated GB | Drainage of P and GB | Recovery | |
| Perforated ulcer | Dilated GB | Drainage of P | Recovery | |
| Perforated ulcer | Normal | Drainage of P | Recovery | |
| Perforated ulcer | Normal | Drainage of P | Recovery | |
| Perforated ulcer | Dilated GB | Drainage of P and GB | Recovery | |
| Cholecystitis | Gall stones | Cholecystectomy | Recovery | Increased diastase in blood |
| Cholecystitis | Gall stones | Cholecystectomy | Recovery | Biopsy of pancreas |
| Cholecystitis | Gall stones | Cholecystectomy | Recovery | Biopsy of pancreas |
| I ntestinal obstruction | Normal | None | Death | Anesthetic death Biopsy |

Abbreviations used GB gall bladder P pancreas

ported as diseased with or without stones. In 6 additional cases the gall bladder was described as distended, but was considered normal in 2 of the latter the organ was opened for drainage but no stones were found. In the

remaining cases the gall bladder was described as normal. Such a designation is of course open to criticism for a gall bladder may look or feel normal to the surgeon and yet show definite evidence of disease when

examined outside the body especially when sectioned for microscopic examination. The point has more than academic interest for it concerns the question already described briefly above of the origin of the patient's pain in these cases. Does it arise from disease of the gall bladder or of the pancreas? The general assumption at least as far as the previous attacks were concerned was that they were of biliary origin. The presence of a normal gall bladder would tend to disprove this idea. McWhorter as already mentioned in at least 4 cases coming to autopsy was able to establish definitely the normality of the viscus. Mention should be made too of the immediate cessation of pain in 3 cases described in which the pancreas was incised at operation suggesting again that the edematous pancreas was actually the source of the pain. The case of Amadon in which no gall bladder was found is also of additional interest. Further observations however particularly enzyme studies, are needed. Until these are forthcoming it must be emphasized impartially that attacks of epigastric pain such as have been described above, should not be assumed without proof to be of biliary origin.

The finding of a distended gall bladder in 6 cases deserves special mention, for it emphasizes the possibility of swelling at the head of the pancreas exerting sufficient pressure on the lower end of the common duct to produce such a bile stasis. The anatomical contiguity of the common duct with the head of the pancreas is well known and in a large percentage of cases it actually traverses the gland parenchyma on its way to the duodenum. The jaundice found in many of the cases herein reported may in fact have been due to such an obstruction rather than any actual biliary disease, even when the latter was present.

Fat necrosis deserves special mention since it is often assumed to be but a part of the picture of necrosis of the pancreas itself. It was present in 15 of the 38 cases here reported even though demonstrable necrosis of the pancreas itself was entirely absent, including those in which actual microscopic study was carried out. There is, moreover, experimental evidence to show that fat necrosis may be produced without actual necrosis of the pancreas.

Thus Opie was able to produce generalized fat necrosis in pilocarpinized cats following simple ligation of the pancreatic duct. The present author has seen not infrequently fat necrosis in dogs in which the pancreas showed merely induration and infiltration with leucocytes and fibroblasts following duct borne infection of the gland.

Treatment in the present series consisted in laparotomy only in 2 cases both recovered. In the others some form of drain was employed. In 2 a drain was simply left in the peritoneal cavity 1 of these patients died. In the remaining patients the drain was placed down to the pancreas, in some after slitting the capsule in some after actually incising the gland lengthwise and in still others apparently without doing anything to the pancreas, although it was difficult to tell exactly from the operative description. In 16 cases the gall bladder was either removed or drained always with drainage of the pancreas all of these patients recovered.

Of the 6 fatal cases 1 died without operation from another cause (Case 14) 4 (Cases 15 17 21 and 27) died within the first 3 days after operation in which drainage of the pancreas was the only procedure employed. The last patient died on the table, undoubtedly from the spinal anesthetic (Case 37).

It would seem from these cases that some type of procedure on the biliary tract is indicated. From theoretical considerations, discussed later drainage of bile is certainly to be advocated either with or without cholecystectomy. From the practical point of view the cases here reported fared better when this was done. In the 4 uncomplicated fatal cases the biliary tract was left intact. It would seem of importance in cases in which the gall bladder is definitely diseased to remove it and provide drainage either through the cystic duct or a separate opening in the common duct following the procedure recommended by Zoepffel. Certainly this gives opportunity to explore the common and hepatic ducts for stones or obstruction. In cases in which the gall bladder does not seem diseased diversion of the bile can be effected by simple cholecystostomy. That the swollen pancreas may by pressure on the lower end of the common duct actually

produce a definite biliary obstruction is apparent from the 6 cases in which a large distended gall bladder was noted. The importance of this factor of biliary drainage has been emphasized by many authors, notably Zoepffel, Archibald, and Stetten.

The drainage of the pancreas was performed in most cases by simply splitting the peritoneum overlying it. In many the pancreas was incised lengthwise. No ill effects were noted from this procedure. In 1 case irritation of the wound edges occurred for a few days but was slight and rapidly disappeared. Drainage of the pancreas effectively relieved pain in 3 cases as noted by the immediate postoperative disappearance of the severe pain.

Pathogenesis The idea of Zoepffel that an acute edema of the pancreas is merely the first step in the development of pancreatic necrosis and hence that this finding represents only early cases is not borne out by the present series of cases, for 12 of them were operated on after an interval of 2 days to several weeks and showed edema without evidence of necrosis or hemorrhage. The frequency of previous attacks which subsided are also against this idea. Analysis of a small series of cases by Quick shows no difference in duration between those revealing edema and those showing necrosis of the gland at operation. From these considerations it would seem that we must be dealing either with a mild type of the same disease which causes necrosis or with a disease of entirely different etiology.

Archibald proposed a theory to explain acute edema of the pancreas by assuming that closure by spasm of a common sphincter of the pancreas and bile ducts allowed bile to run into the pancreas provoking edema. He was able to do this in cats and in this species showed definite signs of an acute inflammatory reaction even with sterile bile.¹ Such a theory depends obviously upon the existence of an appropriate anatomical arrangement of the pancreatic and common bile ducts to permit the entrance of bile into the pancreas.

Professor R. E. Bentley writes that some years ago he and Dr. R. Messinger performed a great many unpublished experiments on the injection of bile into the pancreatic duct of rabbits. A transient edema was produced whenever proper restraint to the injection was not used and extravasation occurred. The edema subsided, in general, in the course of a few days, leaving no permanent damage, or at most a slight fibrosis.

Unfortunately no such observations were made in any of the fatal cases herein reported. It should be searched for in other subsequent cases coming to autopsy. Anatomical studies in the human have, of course, been made. The most complete data can be found in the paper of Mann and Giordano. In a series of 200 autopsies they found that it was anatomically impossible for bile to enter the pancreatic from the common duct, even by spasm of the ampulla of Vater in 80 per cent of the cases. In 20 per cent it conceivably could occur. Although this offers a considerable chance in favor of Archibald's hypothesis they showed in goats at least that the free flow of bile into the pancreas was compatible with life and did not produce severe symptoms, and no microscopic changes in 24 hours. In dogs and cats, however, bile injected at a pressure of 1,000 millimeters of mercury or less produced marked edema. In another species spontaneous edema of the pancreas has been frequently observed (35). It is significant, too, that in this animal the mouse, the pancreas and bile ducts are so arranged that bile can easily enter the pancreatic duct.

Evidence of another sort is available to show, moreover, that a free communication between pancreatic and common ducts in humans does actually occur, though obviously not very often. One such instance is that of a patient who discharged a gall stone through the abdominal wall the fistula later draining fluid identified as pancreatic juice. Another is the record of a patient with a pancreatic cyst in which pancreatic ferments were identified but in whom after marsupialization, bile drained through the opening. Several other cases of this sort may be found in a paper by Brackertz. In a recent report by H. L. Popper of Vienna (J. Am. M. Ass. 1933, 1:2032), similar evidence is described. In 200 gall bladders removed at operation he found increased ferment concentrations which could have been due, he claims, only to influx of pancreatic juice into the common duct.

Of perhaps greatest importance, finally, is the observation of a greenish or yellowish color of the edematous pancreas specifically noted in 7 of the present series (Cases 12, 18, 19, 20, 30, 32, and 33). The same observation was

recorded in another series of cases reported by Quirk as mentioned above. Such a color certainly suggests the presence of bile which apparently had entered the pancreas from the lower end of the common duct. If this proves to be the true pathogenesis its application to the treatment is obvious, for diversion of the bile is obviously indicated and has indeed been recommended by several authors.

The question of the necessity for immediate operation in these cases cannot be answered definitely from this study. Certainly many of the present cases were operated on at the height of the attack because a diagnosis was made of another condition demanding immediate laparotomy otherwise, the only consideration favoring an emergency operation is the possibility that the inflammation may go on and develop into necrosis, suppuration or gangrene of the gland. This is the attitude taken by Zoepffel and others. The evidence against it has already been discussed. It is hoped that with further study of this type of pancreatitis, this aspect of its treatment may be more definitely clarified.

SUMMARY

1. A series of 37 cases is analyzed in which at operation an acute inflammation of the pancreas was found as shown by the presence of edema, swelling and induration but without any evidence of hemorrhage suppuration or necrosis of the gland. Microscopic verification of the lesion was obtained in 6 cases.

2. A similar clinical picture was present in these cases as shown by the frequency of a history of previous attacks the acute nature of the attacks of pain located to the epigastrium radiating sometimes to the left and frequently to the back and its tendency to subside without any special treatment.

3. Evidence is presented in favor of the idea of Archibald that reflux of bile from the common into the pancreatic duct is the pathogenesis in these cases.

4. Observations are recorded pointing to the possibility that symptoms often assumed to be biliary colic may actually be of pancreatic origin.

5. The possibility of making a diagnosis in these cases at the height of the attack by

studies of the pancreatic ferments is emphasized.

6. The presence of glycosuria was noted in six cases.

7. The incorrect pre-operative diagnoses were as follows: intestinal obstruction, 6 perforated ulcer 9 perforated gall bladder 2 duodenal ulcer 2 appendicitis, 1. In 6 other cases, while a diagnosis of gall bladder disease was confirmed the pancreatic lesion had not been suspected.

8. The most effective surgical procedures included, besides drainage of the pancreas itself by incision treatment of the biliary tract, such as bile drainage with or without removal of the gall bladder or by cholecystectomy alone. There was no mortality in the 14 cases in which this was done.

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THE STRENGTH OF WOUNDS SUTURED WITH CATGUT AND SILK

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IMMEDIATELY after a wound is sutured its strength is dependent more on the number of sutures that have been employed and on the holding power of the tissues for these sutures than on the thread strength of the suture material. During healing the strength of the wound can be divided into two distinct periods. In the first, the so called "latent period" lasting until the fourth or the fifth day the strength varies somewhat from that obtained immediately after suturing yet it is dependent on the variations in those factors which determined its strength immediately after suturing. Microscopically this period of healing is characterized by the exudative reaction. In the second period lasting until the wound is completely healed strength increases rapidly and is microscopically associated with the process of fibroplasia. When this second period begins and the rate at which it progresses depend entirely upon the length of the first period. The length of the first period in turn depends upon the extent, character and duration of the exudative reaction. With infection and necrosis for example, the first period is markedly prolonged the second period develops late and the wound gains strength slowly. When on the other hand, the wound heals *per primam*, the exudative reaction is minimal the first period is short and the wound gains strength early.

In all wounds sutures are foreign bodies. The reaction of the tissues to them, therefore is an exudative reaction, and consequently sutures should affect healing through this reaction as well as through their primary mechanical functions. The bulk of the suture material used, the method of insertion, and the tightness with which it is tied, all influence the amount character and duration of the exudative reaction. We suspect, also, that even the chemical and physical nature of the suture material influences the amount, character, and duration of the exudative response.

Halsted believed that he could detect these differences in the external appearance of wounds sutured with silk and catgut—that with catgut the wounds showed less perfect healing than when they were sutured with silk. He wrote "Let the surgeon interested in making the comparison, when he has occasion to amputate both breasts for non malignant disease, take a running subcuticular stitch on the one side with catgut, and on the other with fine silk (No. A or AA) and observe the healing wounds from day to day, or when operating on two gullets on the same day, employ catgut for the platysma suture in one case and very fine silk in the other. There is not only greater local reaction in the cases sewed with catgut but in them the wounds will occasionally open at one or more

points to discharge a few drops of clear or cloudy fluid."

Regardless of the soundness of Halsted's conclusions it is hardly just to attribute the character of healing of operative wounds solely to the suture material employed. Operations differ greatly in the amount of trauma, hemorrhage, and bacterial contamination and therefore can hardly be compared. Moreover healing in patients requiring surgery is usually complicated by disease and disease does influence the healing of wounds (1). Another criticism is that Halsted did not state whether he used comparable sizes of catgut and silk, or if he employed exactly the same technique, i.e. the same sized needles, the same amount of suture material tied at exactly the same tension etc.

From our own experiences, we found that when comparable sizes of silk and plain catgut were carefully embedded under the serosa of the stomach by exactly the same technique, the inflammatory reactions along the suture tracts were very variable. It was only after making numerous examinations at daily intervals that we finally concluded that there was no appreciable difference in the extent of the exudates, but that the exudate remained for a longer period of time around the plain catgut than around the silk. The conditions for studying the extent of exudation in these experiments moreover were relatively simple compared to what they would be in a wound.

However if catgut actually does cause a greater or more prolonged inflammatory reaction than silk, then it should be possible to demonstrate that in experimental wounds the first period of healing strength is prolonged and that less strength is present in the first few days of the second period. Accordingly we have studied the return of strength to wounds sutured both with silk and catgut of the same and different sizes, using exactly the same technique for suturing each wound. For comparisons with these strengths, we have studied the duration of the exudative reactions for each suture material.

Because we have used a laboratory method, we have been able to minimize infection control trauma, to make numerous observations

and to have wounds in healthy animals. As the wounds were cut in the wall of the stomach there was provided not only a tissue suited for testing strength but one favorable to both silk and catgut. No logical conclusions could be reached unless the suture materials were placed in suitable tissues. Catgut, for example, can be used only in very limited amounts in fat for it is absorbed slowly from this tissue, and when used in amounts more than minimal the inflammatory reaction is prolonged and liquefaction takes place. Induration in many clinical wounds especially in those which discharge a "few drops of clear or cloudy fluid," results from using chromic or large amounts of plain catgut in the subcutaneous fat. This all too frequent practice of using catgut improperly in the subcutaneous fat is another reason why the efficacy of sutures should not be judged from observing clinical wounds. The rat was selected for this test because its peritoneal cavity is very resistant to infection yet if one does occur its presence is betrayed by the resulting adhesions. Besides, the rat can be raised under laboratory scrutiny and the factors of age and diet can be readily controlled.

With this method it has also been possible to determine whether the absorption of catgut with its corresponding loss of tensile strength results in a diminution of the strength of the wound during the time when the wound must depend on the suture material for its strength. In contrast, of course, silk retains its thread strength during this crucial period of healing except for the strength it loses in wetting.

METHOD

Hooded rats weighing from 180 to 350 grams were employed. They were divided into two groups one for the wounds which were sutured with catgut and the other for those which were sutured with silk. All of the animals were fed on the same adequate stock diet both before and after the wounds were made.

The wounds were made as follows an incision approximately 1 centimeter in length was made in the rumen or cardiac portion of

the stomach (Fig 1) We always tried to make the incisions about 1 centimeter in length, but if they did vary in length the test would not be affected, for the method compares only the degrees of distention necessary to rupture the weakest area in the tissue regenerating between the severed edges. An incision of greater length, therefore, would only present a greater length of this tissue of the same width and thickness. After the incision was made, the inner or squamous cell layer of this portion of the stomach could usually be distinguished as a separate layer. However, it was not sutured as a separate layer for in so doing the sutures would have to penetrate into the lumen of the stomach. Instead, both layers were approximated, the serosa being sutured accurately with a continuous suture and then slightly inverted with a second row of sutures. The abdominal wall was closed by means of a continuous suture of black silk.

Two sizes of silk and two sizes of plain and chromic catgut were used—O and C silk, and catgut, sizes No 00000 and No 000. With these sizes the effect of suturing with fine sized silk could be compared with suturing with as equally fine sized catgut, the effect of the large strand of silk with the equally large strand of catgut, and the fine with the large sizes in each instance. Table I gives the diameters and thread strengths of these sutures. Chromic catgut of the same sizes was also used to give information regarding the strength of wounds sutured with absorbable materials not as quickly absorbed as the plain catgut. To determine the immediate strength of the wounds, five wounds repaired with each material were tested 15 minutes after suturing. Five animals whose wounds were sutured with each material were then killed each day after the operation from the first through the seventh days. The peritoneal cavities and the wounds were inspected for evidence of infection, and if found, the animals were discarded. The testing of the wound was done as follows. The esophagus was tied off and the stomach removed with a small portion of the duodenum attached. The cannula of the inflating apparatus (Fig 2) was tied into the duodenum

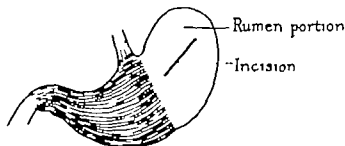


Fig 1 Site of incision.

and the stomach moistened with saline during the test.

The inflating apparatus originally described has been modified somewhat (4). The compressed air tank here in the department of surgery maintains a definite pressure of air automatically (Fig 2). Controlled by the valve *A* this constant pressure was let into a distributing tube to the amount of 10 pounds per square inch. Controlled by the valve *B* this 10 pounds per square inch was then allowed to escape into the stomach. A manometer 1 centimeter in diameter, graduated in millimeters of mercury recorded the escape of this air by means of a writing point. The air was let into the stomach at approximately the same rate for each test and this was determined by watching the rate of ascent of the writing point. During an inflation of a stomach there was only a slight fall in the pressure in the distributing tube, for while air was escaping into a closed system at one end it was constantly being replenished at the other end. When the wound or stomach ruptured there was a sharp fall in pressure and a sharp drop of the writing point. The actual number of millimeters recorded at the height of the curve had to be multiplied by two because the manometer used was of the open type.

To test the efficiency of this apparatus, the mercury manometer was calibrated for the number of pounds per square inch of pressure delivered at the cannula. This calibration was done by attaching an ordinary air pressure gauge to the cannula. The relationship of the reading of the manometer to the pressure gauge was directly proportional and therefore plotted as a straight line. The size of the cannula was found to be the most important factor in causing a discrepancy to

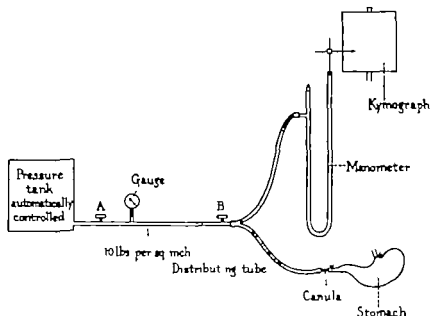


Fig. 2. Schematic representation of apparatus.

occur between the two readings. Not only does the constriction of the cannula cause the pressure to back up in the apparatus, but also the smaller it is, the longer it takes to fill a stomach. For these reasons we have always used as large a cannula as it is possible to use and throughout an experiment have always used the same sized cannula. If for any reason a new cannula was needed the machine was always re-calibrated. Aside from this precaution regarding the cannula, no other changes in the apparatus influenced the correlation between the readings registered by the manometer and the actual amount of air distending the stomach. The head of air pressure in the distributing tube could be set at either 8 or 15 pounds, or different amounts of mercury in the manometer could be used or the rate at which the air was allowed to escape into the gauge could be varied somewhat, provided the change was not too great. The readings of the manometer therefore, represent the true amount of pressure entering into the stomach, provided the same sized cannula, of large size, is used for each test.

Along with the breaking pressure for each test was recorded the weight of the rat and

the location of the rupture given by the test. These breaking pressures for 5 wounds sutured with each of the different suture materials were averaged for each day and plotted as a function of time.

Microscopic sections of two untested wounds from each group were made at the daily intervals. Before being cut, the stomachs were distended with formalin and allowed to fix for 24 hours. Hemotoxylin-eosin stains and Laddlaw silver stains were used. This new silver method devised by Dr. George F. Laddlaw in this department is excellent for demonstrating the fine fibrils of new formed collagen (7).

RESULTS

Regardless of the size of the catgut or silk used, the wounds were of approximately the same strength immediately after suturing (Table II). Thus all the wounds began to heal from approximately the same strength. After the first 24 hours, however all of the wounds increased somewhat in strength a phenomenon which we have described before. From this time, though, and lasting throughout the first period of healing all the wounds steadily lost strength those sutured with silk lost strength until the third day while those

TABLE I
BLACK SILK

| Diameter (millimeter) | Tensile strength (pounds) |
|--------------------------|------------------------------|
| o 15 | 3 3 3 3 3 |
| o 18 | 6 6 6 6 6 |

CATGUT

| Diameter (millimeter) | Tensile strength (pounds) | (tested dry) |
|---------------------------------|---------------------------------------|--------------|
| (tested by U. S. Navy standard) | (both halves of 60 strands) | (catgut) |
| 27—o 15—o 3 | 6—7 | |
| 17—o 17—o 7 | 6—6 | |
| o 15—o 15—o 17 | 6—6 | |
| 27—o 15—o 25 | 6—5 | |
| 17—o 15—o 14 | 5—6 | |
| o 15—o 15—o 17 | 6—6 | |
| (tested by U. S. Navy standard) | (tested dry entire 30' length tested) | |
| o 6—o 16—o 16 | 2 | |
| o 10—o 10—o 8 | 16 | |
| o 10—o 7—o 16 | 3 | |
| o 8—o 18—o 9 | 3 | |
| 17—o 16—o 7 | 3 | |

TABLE II—STRENGTH OF WOUNDS WITH
VARIOUS SUTURE MATERIALS

| | Silk | | Catgut | | |
|----------------------------|------|-------|---------|-----------|-----------|
| | C | O | (plain) | | (chromic) |
| | | | No. 000 | No. 00000 | No. 000 |
| Immediately after suturing | 50 | 60 6 | 70 | 60 6 | 73 |
| 1st day | | 80 | 71 3 | | |
| 2nd day | | 64 6 | 63 5 | | |
| 3rd day | | 53 6 | 44 8 | | 45 |
| 4th day | 6 3 | 64 | 4 8 | 40 | 5 |
| 5th day | 105 | 1 | 70 6 | 67 5 | 77 |
| 6th day | | 4 | 90 2 | | |
| 7th day | | 35 6 | 48 1 | | |
| 8th day | | 158 8 | 47 8 | | |

break elsewhere
[All broke in incision
1 broke elsewhere, alongside
[One broke elsewhere

sutured with catgut lost strength until the fourth day (Fig 3). Further some loss of strength took place regardless of the size or the nature of the suture material employed. Even with chromic catgut there was as much loss of strength as with plain catgut. One can only conclude, therefore, that the loss of strength was not caused by the loss of tensile strength of the suture material alone but rather by the change of all the factors which determine the strength of the wound during the latent period. On the fourth day the wounds sutured with silk had developed new strength and continued to have more strength than those sutured with catgut until the seventh day. On the seventh day one of the wounds sutured with silk had healed to the point where it was stronger than the stomach wall and on subsequent days the number of these increased consistently. On the other hand the wounds sutured with catgut demonstrated an increase of strength only on the fifth day and until the seventh day had less strength than those sutured with silk. Even on the seventh day all of the wounds sutured with catgut disrupted at the site of the wound when tested, and it was not until the eighth day that one of them became stronger than the surrounding stomach wall. After this time the number of those stronger than the stomach wall consistently increased.

The first period of healing strength was therefore one day shorter in the wounds su-

tured with silk than in those sutured with catgut and they possessed greater healing strength throughout the earlier phase of the second period. Moreover, the wounds sutured with silk became stronger than the stomach wall in a shorter period of time than did those sutured with catgut.

When we compared the sizes of silk and catgut with the strength of the wounds we found that the larger sizes did not give any greater strength to the wound than did the smaller sizes of the same material either during the first period of healing or during the second period. Neither were the larger sizes more efficacious in preventing the loss of strength of the wound during the first period again indicating that it is not the thread strength of the suture that determines the strength of the sutured wound. Indeed, the strength of the wound during both periods of healing was found to be attributable to the nature of the suture material rather than to its size. We cannot, of course, say anything about the relationship between the number of sutures employed and the strength of the wound because in these experiments the number was constant. It is important, however, to call attention to the fact that the wounds sutured with the fine silk and catgut had as much strength both immediately after suture

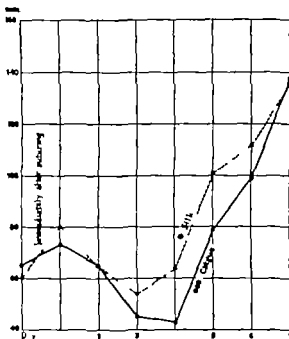


Fig. 3 Strength of wounds sutured with silk and catgut

ing and during healing as did the wounds sutured with the larger sizes.

The microscopic picture of these healing wounds was as follows. Histologically the lumen of the rat's stomach is lined with squamous epithelium surmounted by a thin keratin layer. It rests almost directly upon a well developed muscularis mucosa. Between this and the muscularis, however, is a thin layer of loose areolar tissue which permits the epithelium to adapt itself to the varying states of distention or contraction of the organ. Externally is the serosa. Save for the regeneration of the epithelium and the serosa, the entire re-establishment of the continuity of these wounds during healing was brought about by the proliferation of cells of mesothelial origin. Both grossly and microscopically the site of the wound was thicker than the rest of the stomach wall. This thickening was found to be caused in part by the inversion of the serosa, in part by the thickening of the epithelium at the wound edges, and in part by the formation of granulation tissue between the epithelium and the serosa.

In the wounds sutured with silk, exudation was found after the fifth day of healing only

in rare instances. New fibrils of collagen were first seen in these wounds about the second day (Fig. 4). On the other hand in the wounds sutured with catgut, exudation in most instances continued until the sixth or seventh day. New fibrils of collagen appeared about the third day (Fig. 5).

To summarize the results then there was a definite relationship between the microscopic pictures of healing with the two different suture materials and the strength of the wounds. With silk, regardless of its size the exudative reaction was less prolonged, the regenerative phase began earlier and strength returned earlier. With catgut the wounds had a longer period of exudation, the regenerative phase appeared later and strength returned later. Under the experimental conditions established here, these changes occurred regardless of the size of the sutures used, the finer sizes being just as efficacious in giving strength to the wound as the larger sizes.

DISCUSSION

While it is clear from these experiments that strength returned more rapidly to the wounds sutured with silk than to those sutured with catgut, the impression should not be left that silk is always the suture material of choice. The clinical efficiency of both sutures cannot be evaluated without discussing the limitations of each. Silk must be used according to the careful technique described by Halsted. It has to be used in fine sizes, taking only small bites of tissue, preferably in the fascial layers, and then only as single interrupted stitches. It must not be tied too tightly and the excess of each suture must be cut away right at the knot. Most important of all the technique has to be rigidly aseptic. When these requirements are fulfilled silk is an admirable suture. When, however, they are not fulfilled, its value rapidly diminishes. If the wound sutured with silk becomes infected, the presence of the silk excessively prolongs healing. A draining sinus develops—a sinus which does not close until the silk suture acting as the nidus of the infection sloughs out or is mechanically removed.

Silk should not be used in traumatic



Fig. 4. Wound sutured with silk 6 days after operation. Note that there is no reaction around the silk sutures, and that the wound is well healed. The muscularis is seen on either side of the silk suture. The wound in the epithelium cannot be seen.



Fig. 5. Wound sutured with catgut 6 days after operation. The wound in the epithelium is apparent. Catgut is still present surrounded by many leucocytes. In the midst of the granulation tissue is a small abscess. The muscularis is widely separated.

wounds unless the wound is repaired shortly after the injury and then only after débridement and irrigation. If silk is to be used for suturing in the gastro-intestinal tract, it should not be permitted to penetrate the mucosa for ulcerations occur around silk protruding into the lumen of the gut. In the urinary bladder, silk perforating into the interior may become the nidus of a calculus. The use of silk does not prevent the disruption of operative wounds. O. Sokolov has recently reported numerous disruptions of wounds sutured with silk. However, a higher percentage of disruptions occurred with catgut, indicating the greater unreliability of this material. These conclusions could of course have been anticipated for catgut is rapidly absorbed under circumstances which bring about the disruption of a wound. The use of silk in operative wounds made to drain infected areas is absolutely contra indicated. Silk, like catgut does not do well in fat. Be-

sides with extreme obesity silk is technically difficult to handle.

For all the contra indicated uses of silk catgut is the more desirable suture material.

In all fairness it must be said however that if catgut were used according to the technique required for silk rather than in the mode in which it is usually employed, catgut would be a more efficient suture material. For a number of years I have recommended that catgut be employed in fine sizes, inserted exactly according to the technique described for silk. This recommendation was based on other experimental work showing that the larger sizes of catgut did not have a sufficiently greater holding power in the tissues to justify their use (5). Here, it has again been demonstrated that the use of the larger sizes of either silk or catgut does not impart greater strength to the wound either immediately after suture

ing or during healing. All sutures give greater strength to the wound when employed as smallbite interrupted stitches inserted into the tissues of greatest holding power. Taking large bites of tissue as is far too often the way in which catgut is employed requires that the stitch be tied tightly in order to establish firmness of the cut edges. Such strangulation often results in necrosis. Catgut like silk should not be used as a continuous suture. When it is used in this manner the maintenance of the apposition of the entire length of the wound is jeopardized if one portion of the strand gives way or is absorbed. The more rapid absorption of catgut in the presence of an increased amount of exudate or in collections of serum is really a virtue, for then those interrupted stitches directly in contact with the exudate are absorbed and do not remain as foci of the infection while those not in contact with the exudate hold the wound together. Under similar circumstances, the silk sutures remain as foci of the infection. Because part of the catgut will be absorbed and part will remain one can risk suturing potentially contaminated wounds with this material. Thus it will hold and allow a laparotomy wound made for the removal of an inflamed appendix or gall bladder to heal although at one end of the wound there may be a drainage tract continuously contaminating this portion of the wound.

Regarding the question as to whether the use of catgut in the wound predisposes to infection in clean cases there can be no better answer than that given by Halsted

It should be borne in mind that during the greater part of the period of its disintegration the catgut suture is not only not serving its purpose but is playing the rôle of necrotic tissue of a culture medium. I trust that I shall not be considered flippant in suggesting that the ideal absorbable suture material might be a thread which would serve its purpose for, say ten days and be absorbed in two or three.

Conceded that infection is less likely to occur with silk than with catgut, it would still be objected, and quite pertinently that in case it should occur the buried silk might give endless trouble and have to be removed.

It is well within reason to expect that the technique may be at least so perfect when silk is employed that the wound will become infected not once in a hundred cases. If fine silk were used and the infection slight probably none of the buried threads

would be extruded, nor would healing be delayed demonstrably on account of their presence. When heavy silk has been used for any of the sutures and the suppuration is considerable one or more or perhaps, all of the threads would have to be removed. Even in such case it is very unlikely that the ligatures and fine sutures would give trouble (3)

It can be added of course that it is reasonable to expect also that with catgut the technique can become so perfect that the wound will not become infected once in a hundred cases.

The ideal suture should hold the wound edges together until the wound is healed and it should not be affected by or take part in any untoward reaction during healing. Further it should be absorbed or become innocuous shortly after the wound has healed. Neither catgut nor silk is an ideal suture. Both have their virtues, both their drawbacks. Their efficiencies, however are increased with proper usages. Fortunately silk does not countenance misuse, but unfortunately it is not yet realized that the healing of wounds can be improved and that the occurrence of infection and untoward reaction can be reduced by using catgut according to the silk technique. Both silk and catgut are indispensable to surgery. The indications and contra indications for their use are clearly defined but the decision as to which should be used in any given case must be guided by the nature of the particular wound to be repaired.

SUMMARY

1 Experimental wounds in the stomachs of rats sutured with catgut and silk of the same and different sizes demonstrated that in all the wounds repaired with silk fibroplasia began earlier and the wounds accumulated strength more rapidly than in those sutured with catgut.

2 Microscopic sections of these wounds showed the exudative phase to be of less duration in the wounds sutured with silk than in those sutured with catgut.

3 The experiments showed that there was no advantage in using sutures of large dimensions—the larger sizes of silk or catgut gave no additional strength to the wounds either immediately after suturing or during healing.

4 The efficacy of catgut and silk as suture materials and the indications and contra indications for their use have been discussed. Silk must be employed by a definite technique. Catgut would have greater efficiency, if used according to the same technique.

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THE RÔLE OF THE HÆMATOMA IN FRACTURE HEALING¹

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THE haphazard manner in which provisional callus forms about a fractured bone is a matter of every day observation. There is an abundance of callus in some cases, while in others apparently identical there is little or none. A limited cuff of callus develops about the fracture line when the fragments have been replaced and properly aligned, but when the fragments stand at an angle to each other the callus is usually more luxuriant on the sides of the smaller angle. It is not uncommon, especially in children, to see roentgenographically callus extending from 8 to 12 centimeters from the fracture line in cases in which it is evident that the periosteum could not have been stripped up that distance. In Figure 1 a 6 weeks old fracture in a 3 year old child, the X ray shows much callus growing from the lower fragment upward about the shaft and very little downward from the upper fragment. In Figure 2 an X ray picture of a 35 day fracture in a 16 year old boy we see all the callus on the medial side of the fragments. Such observations duplicated in any series of roentgenograms of fractures of long bones, naturally raise the question: what is the guide for the growth of this intermediary osteoid tissue?

Wolff's law controlling the development of definitive callus according to the demands of stress and strain cannot be in force so long as the fragments are at complete rest separated or entirely free from muscle pull overcome by traction.

Organization of the hematoma as the first step in the healing of broken bones has been known since fractures were first studied histologically. Bier in a series of articles on tissue repair reviews his previous work and re-emphasizes the importance of the hematoma not only as a substratum but also as a stimulant for the growth of new bone. He goes so far as to say that this substratum acts as a nutritive base (*Nährboden*) for the newly growing bone cells. He shows that an excavation in the tibia, filled with blood and

carefully covered with skin will be so accurately repaired with new bone as to reproduce exactly the original shape whereas, the excavation partially filled with blood and improperly covered will be imperfectly repaired with new bone. Lexer believes that blood merely serves as an indifferent filling into which tissue may grow. Kugelmass and Berg by the injection of 5 cubic centimeters of a 1 per cent solution of trypan in the fracture site digested away the blood clot and produced delayed healing while by the injection of fibrinogen into the fracture site more than the average amount of callus was produced.

Many experiments have been performed in which the periosteum has been raised and various substances injected beneath it to stimulate callus formation. Callus will form to some degree under periosteum lifted from bone by the injection of any material whatsoever provided it does not interfere with the bone-forming elements and is stable enough to keep the periosteum raised. The involucrum formed in pus beneath the periosteum after an acute hematogenous osteomyelitis is a perfect example of how new bone will grow into a fluid medium. Pochhammer succeeded in producing new bone by putting dead muscle agar or gelatin between the periosteum and the shaft but he found that it served less well than blood as a nidus for new bone. Fischer injected dead staphylococci into the periosteum and produced new bone on the shaft. Burckhardt injected irritating substances such as 10 to 20 per cent lactic acid and sodium chloride into or beneath the periosteum and produced huge masses of bony callus. Injection of blood twice daily likewise produced extensive callus.

The object of these experiments is to determine whether bony callus will follow a blood clot extending away from the point of bone injury, outside of the uninjured unraised periosteum.

In the first series of 10 animals the radius was sawed entirely across, the ulna acting as



Fig. 1. Six weeks old fracture in 3 year old child. The X ray picture shows much callus about the upper and very little about the lower fragment.

a splint and an attempt was made to keep the operative field dry in some cases and in others to allow a large hematoma to form about the sawed ends. Difficulties were at once encountered. It was impossible in the control animals to maintain an absolutely dry field. Slight oozing from the bone ends persisted in spite of the utmost care. Secondly, it was impossible to eliminate the factor of trauma—a stumbling block in many of the comparative studies on the rate of fracture healing. Some animals walked about on the leg operated upon almost immediately while others protected it for days. It became apparent that unless fixed conditions could be established the work would not be conclusive. This first group of experiments merely indicates what is more definitely established in the second series.

Dog 8. The right radius was sawed across. All blood and bone dust were carefully wiped away and fresh blood allowed to flow into the wound and clot about the bone ends. Closure was done with subcuticular catgut. The wound remained clean. The X ray picture (Fig. 3) taken 30 days after operation shows a large amount of callus about the bone ends. Compare this with the following experiment.

Dog 10. The right radius was similarly sawed across. All blood and bone dust were sponged out and after all bleeding had apparently stopped the wound was closed. It remained clean. The X ray picture (Fig. 4) taken 31 days after operation shows some callus but decidedly less than in Figure 3.



Fig. 2. Thirty five day fracture in a 16 year old boy. The X ray picture shows all the callus on the medial side.

Other animals showed similar indicative variations with the exception of two, one in which a large amount of callus developed in a supposedly dry field and another in which very little callus appeared about the bone ends covered with blood. Making room for a large blood clot by cutting out a piece of muscle resulted in the development of more luxuriant callus. Drawing a piece of live muscle over a displaced fragment of course prevented the growth of callus.

SECOND SERIES OF EXPERIMENTS

To obviate the uncertain factors of trauma concealed bleeding and variation in animals a second series of experiments was performed on 16 dogs each animal serving as its own control.

Under strictly aseptic precautions the radius or femur was exposed on one side and cut one half across with a 1 millimeter wide saw. All bone dust and blood which might contain particles of bone were wiped away



Fig. 3. Dog 1. Extensive callus formation in a hematoma 30 days after transverse section of the radius.

Fig. 4. Dog 8. Slight callus formation in a dry field 3 days after transverse section of the radius.

Fig. 5. Dog 10. Bony callus formation in the hematoma over a saw cut in the left radius; none on the control side.

without injuring the periosteum. Bleeding was minimal. Blood from the hematoma was then obtained from a vein and poured over the point of bone injury where it was allowed to clot. The muscles were closed loosely enough to avoid spreading the newly formed

hematoma. The skin was closed with fine subcuticular catgut.

The corresponding bone on the opposite side was treated similarly except for the blood clot.

Three of the typical protocols are reviewed briefly. The summary of all the results is given in Table I.

Dog 10. Operation February 23, 1938. Hematoma placed over single saw cut in left radius, right radius dry. Dog died March 25, 31 days after operation. Postmortem examination revealed over the defect in the left radius a rounded heap of bony callus 1.5 millimeters high by 11 millimeters long and 7 millimeters wide (Fig. 5). The shaft at this point is 7 millimeters in diameter. Lying on the periosteum over an area extending from approximately 2 centimeters above to 2 centimeters below the point of bone injury are multiple deposits of calcium salts varying in size from pin point to 1 millimeter in diameter. Blood pigment stains are still visible.

The injury to the right radius is smoothly repaired. No deposits of calcium salts are noted.

Microscopic examination. The mass of tissue lying over the bone defect consists largely of newly



Fig. 6. Dog 9. Microscopic picture showing the vascular bony callus on the shaft of the left radius at the site of the hematoma.

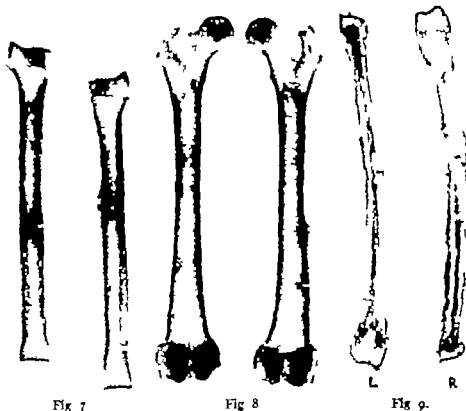


Fig 7

Fig 8

Fig 9.

Fig 7. Dog 18. Moderate bony callus at the site of the hematoma over a saw cut in the left radius, a little callus on the control side. (This is the only animal in which callus developed in the absence of a hematoma.)

Fig 8. Dog 24. Large bony callus in a hematoma above the saw cut in the left femur: none on the control side.

Fig 9. Dog 68. Photograph showing the bony callus at the site of the hematoma over the saw cut in the right radius: none on the opposite side where fibrin overlay the bone injury

formed vascular bone laid down in irregular fashion (Fig 6). The spaces between the bone islands are large and contain blood. This mass of new bone is firmly attached to the shaft. There is no evidence of the buried periosteum of the shaft over which the blood clot was placed. Fibrous tissue or new periosteum covers the entire new growth of bone. There is callus in the bone defect only on the control side.

The masses of calcium, amorphous in structure are stained deep blue by hematoxylin and lie in the connective tissue on the periosteum.

Dog 18 Operation February 18, 1932. Hematoma over the saw cut in the left radius, right dry. Killed April 12, 54 days after operation. Postmortem examination revealed bony callus over the defect in the left radius 3.5 millimeters high by 19 millimeters long (Fig 7). The diameter of the shaft at this point is 7 millimeters. No calcium deposits. On the control side there is a little bony callus 1.5 millimeters high by 7 millimeters long. This is the only animal in which there was any callus on the control side. Bleeding may have occurred after the operation.

Dog 24 Operation February 28, 1932. Hematoma placed over the saw cut in the left femur. Muscles cut to allow more room for blood. Right femur dry.

Dog killed March 28, 28 days after operation. Postmortem examination revealed the hump of bony callus on the left to be 5 millimeters high and lying 2 centimeters above the point of bone injury. From this high point it extends downward in a sloping manner to 7 millimeters below the saw-cut in the bone (Fig 8). No calcium deposits are seen. Microscopic examination shows no evidence of infection. The cut in the right femur is smoothly healed.

In 9 animals there was a variable amount of bony callus or calcium deposits or both on the experimental side where the hematoma was placed over the bone defect, and in only 1 a small amount of callus on the control side. In 7 animals there was neither calcium nor callus on either side. The single instance in 16 experiments of callus formation on the control side is well within the limit of experimental error. We assume that a too rapid absorption of the hematoma was the cause of the absence of callus in 6 instances, in the first place because no calcium deposits



Fig. 8. Dog 68. Macroscopic picture showing the bony callus on the shaft at the site of the hematoma. The separation of the callus from the shaft occurred in the fixing process.



Fig. 8a. Dog 68a. Very small amount of callus not visible grossly or roentgenographically where the fibrin overlay the bone defect.

were found in any of these dogs, and in the second place because of the tendency of a hematoma to absorb readily under actively moving muscles.

THIRD SERIES OF EXPERIMENTS

Since it could be shown that bony callus will grow into a blood clot it seemed worth while to determine whether it would develop in a similar manner in a mass of autogenous fibrin.

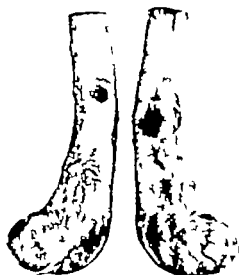


Fig. 11. Dog 77. Photograph of the new bone formation about a defect produced in the left femur and covered with blood. No bony filling of the defect on the right covered with fibrin.

In this series of 15 dogs the following experiments were performed the same technique being used as outlined above in the second series. The radius or femur was exposed on one side a defect in the bone was produced and a hematoma was allowed to form over the site of bone injury. On the opposite side a similar defect was produced and all blood carefully wiped away. From 20 to 30 cubic centimeters of blood was then withdrawn from the animal's vein and de-fibrinated. The fibrin was washed at least three times in normal salt solution, squeezed dry placed over the bone defect and held there by a couple of stitches through the overlying muscle. In a few instances in which the tendons or muscles were cut on one side to allow more room for a hematoma they were also cut on the opposite side and the fibrin mass laid in the defect.

The essential details of only two experiments are given.

Dog 68. Operation September 27, 1932. Hematoma was placed over saw cut in the right radius extending well into the medullary cavity. A mass of fibrin about the size of the end of an adult thumb was placed over a similar cut in the left radius. Dog killed October 27, 30 days after operation. Postmortem examination revealed a mass of bony callus 15 millimeters long by 3 millimeters high overlying the site of bone injury on the right (Fig. 9). There is grossly no callus on the right and only a few strands of fibrous adhesions, no evidence of the fibrin. Microscopic examination confirms the gross and roentgenographic findings (Figs. 10 and 10a).

TABLE I

| | | | | | | | Results | | | |
|-----|------|--------------------|--------------------|-------|---------------------|--------------------|---------------------|---------|----------------------------------|---------|
| | | | Experimental bone: | | Type of bone defect | | Calcium deposits | | Callos formations in millimeters | |
| Dog | Days | Shaft diameter mm. | Radius | Femur | Single saw cut | Piece chiseled out | At site of hæmatoma | Control | At site of hæmatoma | Control |
| 17 | 41 | 5 | × | | × | | ++++ | o | 5x15 | o |
| 18 | 54 | 7 | × | | × | | o | o | 3 5x19 | 5x7 |
| 19 | 31 | 7 | × | | × | | + | o | 1 5x11 | o |
| 20 | 7 | 6 | × | | × | | +++ | o | o | o |
| 21 | 3 | 5 | × | | × | | +++ | o | 1 5x13 | o |
| 3 | | 5 | × | | | × | o | o | 1 5x20 | o |
| 4 | 28 | 11 | | × | | × | o | o | 5x20 | o |
| 32 | 3 | 5 | × | | × | | +++ | o | o | o |
| 34 | 18 | 6 | × | | × | | o | o | 1 5x 5 | o |

In seven animals there were no calcium deposits or callos formations on either side

TABLE II

| | | | | | | Results | | | |
|-----|------|-------------------|-------|---------------------|--------------------|---------------------|-------------------|---------------------|-------------------|
| | | Experimental bone | | Type of bone defect | | Calcium deposits | | Callos formation | |
| Dog | Days | Radius | Femur | Single saw cut | Piece chiseled out | At site of hæmatoma | At site of fibrin | At site of hæmatoma | At site of fibrin |
| 50 | 34 | × | | × | | o | | o | 1x3 mm. |
| 51 | 31 | × | | × | | ++ | | 5x13 mm. | o |
| 52 | 26 | × | | × | | ++++ | o | 5x20 mm. | o |
| 53 | 31 | × | | × | | o | • | 1x7 mm. | o |
| 54 | 28 | × | | × | | | | o | o |
| 56 | 5 | × | | | × | | + | Small nodules | Small nodules |
| 59 | 5 | × | | | × | ++ | o | Small nodules | Small nodules |
| 62 | 13 | × | | | × | o | o | Small nodules | Small nodules |
| 65 | 13 | × | | | × | o | | o | o |
| 67 | 30 | × | | | × | ++++ | ++++ | 4x13 mm. | 5x20 mm. |
| 68 | 30 | × | | × | | o | o | 7x20 mm. | o |
| 73 | 31 | | × | | × | • | o | 1x5 mm. | o |
| 74 | 13 | | × | | × | ++ | o | Osteoid tissue | o |
| 77 | 11 | | × | | × | + | o | 3 5x3 mm. | o |
| 78 | 11 | | × | | × | o | o | 5x4 mm. ridge | |

Dog 77 Huge police dog. At operation, November 23 a piece of bone about 15 millimeters in diameter and 3 to 4 millimeters deep was chiseled out of the left femur about 6 centimeters above the condyle. A hæmatoma was allowed to form over the defect. Over a similar defect in the right femur a

large mass of fibrin washed 5 times in normal salt solution was placed. The muscle was cut on the left on the right it was cut and repaired at once. Seven days after operation 5 cubic centimeters of autogenous blood was injected into the site of bone injury on the left side. Dog was killed December 14

21 days after operation. Postmortem examination revealed about the defect in the left femur a circular ridge of bony callus 2 to 4 millimeters high and 8 millimeters wide (Fig. 11). A few small deposits of calcium salts are noted. The depression in the right femur remains practically the same as it was at the time of operation except for an overgrowth of fibrous tissue. There is no sign of the fibrin. Microscopic examination shows no sign of infection.

The results of all the experiments of this series are summarized in Table II.

DISCUSSION

A considerable quantity of blood left undisturbed in the fascia or muscle forms a firm elastic mass or hematoma which is either absorbed or finally replaced by connective tissue. The process of healing about a broken bone is different. The hematoma is early impregnated with calcium salts transformed into osteoid tissue, and eventually into bone. If for some reason the normal processes do not occur and the weedy connective tissue overgrows the space about the broken bone ends, fibrous union is the result.

In every fracture there is injury to at least two structures: the bone itself and the connective tissue about the fracture. There is always some bleeding. The blood is one of the important factors in the healing process. It clots about the bone ends, and in so doing forms a framework for the ingrowth of new tissue. Robeson in 1923 demonstrated an enzyme phosphatase which will cause the precipitation of calcium phosphate from the readily soluble calcium hexose monophosphoric esters. This enzyme he extracted from all tissues but especially from bone and callus and urinary epithelium. It seems more than likely that this enzyme secreted by the fractured bone is taken up by the hematoma, stimulates the deposition of calcium salts from the newly established capillary circulation, and influences the process of ossification. In our experiments calcium salts in large quantities were laid down as far as 2 centimeters from the site of a 1 millimeter wide cut halfway across a bone. These calcium depositions were greater than could

have been derived from the clot itself. In no instance were there appreciable calcium deposits about the site of bone injury in the absence of an overlying blood clot. There is no basis for saying that the hematoma is anything more than a medium in which something—very probably an enzyme—is held and where it may come in contact with the newly forming circulation and stimulate the deposition of new bone. The fact that no calcium salt depositions or bony callus formations appeared over the site of bone injury in the absence of a hematoma suggest that this activating substance secreted by the injured bone was diffused or absorbed before bone forming activities could occur.

Hematomata were made in the abdominal wall and in the fascial sheaths of the thigh in a number of animals. In no instance were calcium deposits seen, either grossly or microscopically after periods of 3 to 10 days, whereas there were extensive deposits of calcium as early as the third day in a hematoma overlying an injured bone.

CONCLUSIONS

The hematoma about a fracture is a suitable medium for the deposition of calcium salts and the formation of bony callus. Fibrin is less effective than blood as a medium about a bone injury into which osteoid tissue may grow.

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"MILK OF CALCIUM" BILE

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MEDICAL literature is dotted with occasional reports concerning biliary calculi which consist of pure or almost pure calcium carbonate. But nowhere in the literature have the writers, after an exhaustive search, been able to find an exact counterpart of the case which they are presenting, namely, one in which the gall bladder contained virtually pure calcium carbonate in suspension, resembling "milk of calcium." Several cases, however, similar in some respects to the one under consideration but all associated with stones in the gall bladder were encountered in the foreign literature, and will be reviewed below.

REPORT OF THE CASE

This patient (R. G.) an unmarried female aged 24 years, was admitted to the Montefiore Hospital, November 20, 1930 giving a history that at the age of 13 years, while still in Europe, she was confined to bed with a febrile condition, diagnosed at different times as influenza and malaria. The patient at that time was so young that her memory is not clear concerning the details, but she was quite certain that this illness had been associated with repeated attacks of chills and fever. After her recovery she was apparently well for about 6 months, when she became subject to frequent nocturnal attacks of right hypochondriac pain, which persisted for several months. Following this, there was an interval of relief for about 2 years, when, in 1921 she emigrated to the United States. Shortly thereafter the attacks of pain recurred. At first they began in the right hypochondrium and radiated around the right costal margin to the back, but recently the pains altered their course, radiating upward sub-sternally being associated with bloating and belching. Several times the attacks were so severe that morphine had to be given. Between the attacks, she complained of epigastric distress after the ingestion of any solid food. There were frequent nausea, occasional belching and some acid regurgitation. Fried and delicate foods aggravated the distress. Constipation was moderate and was relieved by mineral oil.

Physical examination was negative except for definite epigastric and right hypochondriac tenderness. The Boas point was positive for tenderness, as were also the tissues in the region of the right acromioclavicular joint. Routine examinations of the urine were negative. There was a slight anemia. The Wassermann and Kahn tests were negative.

A roentgenogram of the gastro-intestinal tract taken in October 1930 revealed only normal structures. On the gastroduodenal plates, however, just outside the pylorus, in the region of the gall bladder is a small shadow which assumes on some of the films a crescentic shape (1.25 centimeters by 0.4 centimeter), while on others it appears oval in outline (2.0 centimeters by 1.7 centimeters) and suggests the possibility of a gall stone although a diverticulum of the second portion of the duodenum must be considered." (Figs. 1, 2) On the colon plates this shadow was still present (Fig. 3) A cholecystogram taken 12 hours after the dyestuff was administered revealed no definite shadow of the gall bladder but there is an oval shadow which corresponds very closely to the shadow noted at the previous examination, and still suggests the possibility of the presence of a gall stone. In the region of the cystic duct is another but much smaller shadow also suggestive of a gall stone. Following the fatty meal, no change was observed in the shadows in the region of the gall bladder. Re-examination of the gall bladder taken a week after the above, and without the administration of dyestuff, revealed a shadow strongly suggestive of an enlarged gall bladder at the very bottom of which appears to be an oval stone of the same size as already mentioned, which shifts its position and changes its shape depending upon the posture of the patient. In the cystic duct area the shadow previously noted still persists, suggesting a small occlusive calculus situated in the lumen of this structure (Fig. 4).

At operation November 24, 1930 the upper abdomen was opened through the usual oblique incision, extending from the ensiform cartilage down to and a little to the right of the umbilicus. Aside from the gall bladder exploration of the abdomen revealed only normal structures. There were no evidences of hepatitis, the right border of the liver retaining its normal hatchet like edge. The gall bladder was tensely distended, and the seat of a hydrops. No stone such as was suggested by the X ray plates could be palpated in the gall bladder although the tenseness of the viscus precluded the possibility of palpating a stone even if it were there. Further exploration revealed a small calculus completely obstructing the cystic duct. An attempt to milk this stone into the cavity of the gall bladder failed. Clamps were applied to the cystic duct proximal to the stone, and the gall bladder and cystic duct including the stone were removed from below upward. The removal of the gall bladder was just about completed when, due to the extreme thinness of its wall it was inadvertently nicked. This resulted in the escape at first, of "white bile" which in turn was followed by the escape of a substance strongly re-

sembling a chalk mixture. The opening in the gall bladder was quickly clamped, and the removal completed.

The report of the pathologist follows. "The specimens consisted of a gall bladder and a full test tube containing a milky white fluid with a heavy sediment (Figs. 5, 6, and 7). The gall bladder was pear shaped, moderately distended, and opaque. The serous covering was fibrosed. When the gall bladder and cystic duct were laid open, the latter was found completely occluded by a greyish white calculus rather soft and friable, about the size of a large pea. The gall bladder itself contained no stones, but was filled with a seromucinous fluid and at the dependent portion of the viscus, there was a white sediment resembling finely precipitated chalk. The mucosa was pearly grey in color, with numerous bands of fibrous tissue replacing its normal rugae. Microscopic sections of the gall bladder wall showed complete replacement by fibrous tissue. The normal trabeculae and the columnar epithelium of the mucosa were replaced by connective tissue. In the crypts could be seen small deposits of what appeared to be calcium salts. The submucosa was the seat of a mild mononuclear infiltration.

Analysis of the fluid found in the gall bladder follows. "It was milky white in color. On standing a heavy chalk-like substance settled to the bottom of the test tube, leaving a clear colorless supernatant fluid. After centrifugalization, the solid matter was found to represent 15.6 per cent of the total volume the rest was crystal-clear liquid. Chemically it contained a faint trace of albumin, a trace of mucin and very small amounts of chlorides and bile salts held in solution. Part of the solid residue was desiccated and found to be insoluble in fat solvents, such as ether, chloroform and benzene very weakly soluble in dilute acids partially soluble in strong nitric, sulphuric, and phosphoric acids. It also gave off carbon dioxide gas. Another portion was digested with a phosphoric-sulphuric acid mixture, which destroyed all the organic matter. After complete charring, only 8.5 per cent of the original weight was lost. The study of the inorganic portion proved it to consist entirely of pure calcium carbonate. The 8.5 per cent organic matter was composed of salts of glycocholic and taurocholic acids. No bile pigments were present. A microscopical study of the sediment proved it to consist of virtually pure amorphous granules of calcium carbonate, only an occasional crystal of calcium carbonate and bile salts being detected. Chemical analysis of the cystic duct stone showed that it likewise consisted of virtually pure calcium carbonate.

Because of these most unusual gall-bladder findings, it was deemed advisable to study the patient's calcium metabolism. All the pertinent blood and urine findings are here recorded. Blood sugar 92 milligrams per 100 cubic centimeters blood non-protein nitrogen, 29 milligrams per 100 cubic centimeters blood uric acid, 2.4 milligrams per 100 cubic centimeters blood phosphorus, 4.0 milligrams per

100 cubic centimeters blood cholesterol, 200 milligrams per 100 cubic centimeters blood calcium, 14.4 milligrams per 100 cubic centimeters (December 10, 1930) blood calcium, 14.4 milligrams per 100 cubic centimeters (December 13, 1930) blood carbon dioxide, 64 volumes per cent urobilin, negative urine calcium 833 milligrams in 805 cubic centimeters urine (total 24 hour specimen) icteric index, 7 van den Bergh direct, negative indirect, negative.

Röntgenograms of the entire skeleton taken not only because of the obviously disturbed calcium metabolism, but also because the cholecystogram had revealed calcium deposits in the cartilages of the ribs, were quite negative, the roentgenologist reporting as follows: "No radiographic evidence of abnormality in the manner in which the calcium is deposited in the bones. There is neither deficiency nor any sign of calcareous deposit."

A checkup on the blood findings was made on April 4, 1931 over 4 months after operation, revealing the following: Blood calcium, 8.6 milligrams per 100 cubic centimeters blood phosphorus, 4.2 milligrams per 100 cubic centimeters blood uric acid, 2.1 milligrams per 100 cubic centimeters, blood carbon dioxide, 53 volumes per cent icteric index, 7.

Another checkup, made on March 20, 1932, 16 months after operation, revealed the following: Blood calcium, 9.8 milligrams per 100 cubic centimeters blood phosphorus, 4.2 milligrams per 100 cubic centimeters.

Since operation, the patient has had no recurrence of former symptoms.

RÉSUMÉ OF THE LITERATURE

As was stated above, a search of the literature failed to reveal a record of any case similar to the one with which we are dealing. In Germany however Volkmann in 1924 removed from a 30 year old woman who gave a typical history of cholelithiasis a long and somewhat enlarged gall bladder the cystic duct of which was occluded by a cherry size stone. The viscus contained instead of normal bile a white, opaque fluid, resembling milk of calcium," in which there were found five mulberry shaped stones. The latter were colored light yellow and in areas presented whitish layers of lime. Microscopical analysis revealed the presence of calcium carbonate crystals. Chemical analysis proved the presence of cholesterol an abundance of carbonates and smaller amounts of sulphates and chlorides. Bilirubin was weakly positive.

In 1926 the same author reported the pathological findings of a gall bladder removed from a woman 46 years old who for 5 years pre-

viously also suffered from rather typical attacks of cholelithiasis. At operation the removed organ was found to be the seat of a chronic cholecystitis, as evidenced by the marked thickening of the wall, the cystic duct being occluded by a stone. The gall bladder contained a milky fluid and two stones. "An accurate chemical analysis proved conclusively that we were actually dealing with a bile like 'milk of calcium,' and not with the so called 'white bile' described by Kausch and others, which occurs in the various types of obstruction of the biliary passages." Unfortunately, no mention was made of the composition of the stones contained within the gall bladder.

Demel and Schultze, in 1927 reviewed Volkmann's findings, supplementing these with an additional case. This patient, 33 years of age injured 11 years previously with a pitch fork, had developed a severe generalized septic infection with secondary metastatic abscesses. Recovery from this infection took 5 years. During the following 6 years she was entirely well, when she developed symptoms of an acute cholecystitis with the formation of a mass which was diagnosed as an enlarged gall bladder. After a second attack, a tensely filled gall bladder, which could not be emptied on pressure, was removed. In the removed viscus were found 'four pea sized stones, dark greyish brown in color, a few hard stones with uneven surfaces, also a stone a little smaller than the rest, white, covered with brown 'warts' soft and friable, inside of which was a brownish white design. The larger stones had a covering of brownish white hue. On the whole they showed a structure resembling concentrically arranged crystals, with irregular brownish white designs. Microscopically they revealed, in addition to numerous cholesterol crystals, crystalline calcium, as well as pigment in quite irregular layers. On opening the gall bladder, a viscid, milky, quite opaque fluid escaped, after evacuation of which were noticed white 'clots' which covered the entire mucous membrane in spots forming little masses the size of lentils. Microscopic examination of the gall bladder wall showed the characteristic picture of acute cholecystitis

with destruction of the mucosa." Examination of both stones and sediment showed them to consist principally of calcium salts. While the authors do not specifically state that there was calculous obstruction of the cystic duct, such was probably the case, since from their own description they had encountered an acutely distended stone containing gall bladder which did not empty on pressure.

While the following 2 cases are to be distinguished from those just quoted by the difference in the consistency of the material contained in the gall bladders they are here mentioned because the major portion of this material was found to be almost pure calcium in some form.

In 1930, Sasse reported the case of a 51 year old woman, who, having suffered for 8 years from typical gall stone colic presented herself with jaundice and a mass in the gall bladder region. A cholecystogram showed a dense shadow the size of a walnut situated in the gall bladder region. The gall bladder was removed, and on examination its lumen was found filled with a plastic, doughy gum like material of somewhat whitish green yellow color which at first was thought to be the contrast medium taken 3 days previously for X ray purposes. In this tenacious mass were found lodged 14 round, smooth green gall stones varying in size from a pinhead to a pea. It was the impression of the examiners that the contrast medium introduced for X ray purposes might have given rise to gall stone formation. Histologically there was found a chronic cholecystitis with ulceration and atrophy of the mucous membrane. The gall stones consisted of a nucleus of pigment, with a covering layer of cholesterol. Chemically it was shown that the yellowish white doughy mass was pure calcium carbonate.

Churchman, in 1911, reported a case somewhat similar to Sasse's. This case was one of acute cholecystitis with complete calculous occlusion of the cystic duct, which came to operation. The gall bladder contained neither bile nor pus. It did, however contain a peculiar fluid with an odor suggestive of a mixture of cod liver oil and turpentine. This material had a consistency similar to that of tooth paste. "It had no property of adhesion

whatever and when handled failed to come into intimate contact with the skin of the finger from which it was separated apparently by a thin layer of oil. None of it stuck to the finger though its peculiar oily odor remained on the skin. It was ductile, and could be pulled out in strands, like pulled candy but it was somewhat elastic. A chemical analysis of this material showed it to consist largely of the soaps of calcium salts.

FACTORS INFLUENCING THE DEPOSITION OF CALCIUM IN THE GALL BLADDER AND BILE DUCTS

According to Wells, pathological calcification occurs in two forms—one is a precipitation of calcium in the secretions and excretions of the body the other is the deposition of calcium salts in the tissues themselves. It is the former with which we are at present concerned. In the various classifications of biliary calculi all authors list the calcium carbonate stone as being very rare and while some classify amorphous and incompletely crystalline cholesterol stones among the rare types, no mention is made of pure amorphous and crystalline calcium carbonate in gall bladder contents, as was found in this case. A search of the literature reveals no explanation for such an occurrence. Certain factors influencing this process however are available, and will be considered below.

Aschoff (2) in his *Lectures* quotes Naunyn's contention that calcium is a secretory product of the inflamed mucous membrane of the gall bladder. Aschoff himself contends that for the formation of the cholesterol-pigment-calcium stone a medium, rich not only in protein but also containing bile is unqualifiedly necessary. But he feels that besides infection other factors must be present in the formation of any stone namely abnormal chemical combinations in the bile, dysfunction of the biliary system and stasis. Thus, holding to his contention that gall-stone formation may occur under different conditions Aschoff quotes Rous and McMaster's (15, 16) investigations. These workers found in dogs whose bile passages had been intubated for a long time a formation of calcium carbonate precipitate as well as organic flocculi on the walls of the

glass and rubber cannulas. They also found concentrically laminated bodies in the bile of men who suffered from cholelithiasis, and believed for this reason that they had come upon the true cause of gall stone formation. They believe that wherever the formation of precipitates of organic substances is possible for a long time a precipitation of bilirubin-calcium or calcium carbonate can occur. They are, therefore, of the opinion that infections of the bile passages do not so much prepare for gall stone formation by furnishing an exudate rich in protein and calcium as by a sort of paralysis of the wall, which no longer contracts when in an inflamed condition, and can no longer remove the precipitated structures. Aschoff does not agree with this opinion, since he recognizes only sedimentations, but no true stone formation in the protein and calcium precipitates found by Rous and his co-workers in the dog.

Of interest in this connection is Aschoff's statement that in the development of every cholesterol-pigment-calcium stone, one must differentiate three periods, viz (1) the period of crystallizing out, that is the peculiar formation of rosettes (2) the period of agglutination that is, the accumulation of the rosettes into the so called nucleus and (3) the period of apposition, that is the formation of the cortex. He also points out the fact that the precipitates in the crystallization and agglutination periods are usually richer in calcium than the precipitates of the apposition period and he believes that this strongly favors the view that the increased calcium content of the center must be caused by something special namely by the admixture of the exudate. Wells quotes evidence suggesting that the presence of the positively charged protein substances in inflammatory exudates leads to the precipitation of calcium bilirubinate, which is electro-negative, from the bile and hence the formation of pigment-calculi is favored or initiated by inflammation of the biliary tract.

Wakeley and Buxton assert that in all inflammatory conditions occurring in the bile passages, the calcium content of the secretion is increased. They also state that normally the calcium in the bile is concentrated but

when stagnation occurs, the concentration may proceed beyond the normal amount, and precipitation follow. This concentration of bile occurs also in obstruction of the larger bile ducts when obstruction to the flow occurs but not to the same extent as in the gall bladder. MacCallum emphasizes the fact that whereas cholesterol is a normal constituent of the bile, and crystallizes out from it, calcium appears in appreciable quantities only during the course of inflammation. Lichtwitz and Bock, discussing calcium content of bile and its importance in the formation of gall stones, state that calcium is found in all gall stones, some in the radiating cholesterol stones, and larger quantities in all other forms. They assert that calcium originates in the bile, and the closest supposition is that when the calcium content of the bile is high calcium stones are formed and that when the cholesterol is high, cholesterol stones are formed. This supposition is at the basis of the conception of the formation of gall stones as propounded by Aschoff and Bacmeister (3) an increase of the bile calcium occurring in inflammatory conditions of the biliary ducts and particularly in stagnation of the contents of the gall bladder. Aschoff and Bacmeister are of the opinion that in cholecystitis with inflammatory exudate and increase in mucus there arises a large increase in calcium which then brings about the formation of calcium containing stones or strata. In spite of this overwhelming evidence of the production of calcium in inflammatory processes Lichtwitz and Bock failed to find any increase in the bile calcium obtained from inflamed gall bladders.

Rous, McMaster and Drury (17) point out that the acidification of the bile plays a part in the solubility of calcium carbonate in the bile. The solubility of calcium carbonate is known to be markedly affected by the fluid in which it is contained. The normal liver bile out of which it tends to precipitate is alkaline with an average hydrogen ion concentration of 8.2, but in the gall bladder where conditions might otherwise seem favorable to precipitation, the secretion undergoes a change toward the acid side, becoming on long sojourn there, strongly acid to litmus

(pH 5.8 to 6.0). From bile thus altered, no carbonate precipitation takes place, even when it becomes greatly concentrated as in fasting animals or after obstruction of the common duct. It is this function of the gall bladder, namely to acidify the bile, which is responsible for the absence of calcium precipitation from the normal gall bladder. This being the case, one might suppose that the failure to act would be followed by the formation of carbonate stones. There is sufficient evidence available in the literature to indicate that this happens in rabbits, at least. These same authors further confirmed the observations of others, that bile from the gall bladders of animals was more acid than bile which had been freshly secreted by the liver. They found similar differences in human specimens, and observed further that the acidity of dog bile increased progressively with the time of its stay in the gall bladder. A study of the calcium concentration showed that it rose and fell with the hydrogen ion concentration and that calcium carbonate and cholesterol were precipitated from alkaline bile, whereas acidification prevented the precipitation. Rous and his co-workers showed that one of the functions of the gall bladder was to acidify the bile, and thereby increase its solvent power for calcium, and perhaps for cholesterol.

Neilson and Meyers observed that in gall bladders so injured by infection as to lose the power of acidifying the bile the hydrogen ion concentration remains that of the secretion as derived from the liver. According to Wells the deposition of calcium salts depends on several conditions among which are listed increased alkalinity or decreased carbon dioxide in the tissues, the formation within the degenerative area of a substance having a special affinity for calcium, the production of a physical condition favoring the local absorption of salts the least soluble salts accumulating in excess.

While this paper was in the process of preparation, Phemister (12) at the 1931 meeting of the American Medical Association, reported 7 cases of calcium gall stones rich in carbonate finding that there was constant in them complete cystic duct obstruction, which leads him to conclude that the latter is the *sine qua non*

of the high calcium content of gall stones. He states, without adducing proof that the sequence of events is as follows: a moderate cholecystitis (none gave a history of severe acute cholecystitis) with a cholesterol or cholesterol pigment stone formation the impaction of a stone in the cystic duct (in 1 case the obstruction was due to a carcinoma) sufficient to cause complete obstruction excretion of mucus and calcium carbonate by the gall bladder wall forming a semisolid to soft white stone and incorporating other stones when they are present. He and his associates admit that no explanation has been found for the selective excretion of calcium carbonate by the gall bladder wall. They suggest that it may be that it occurs only when the inflammatory process and the obstruction are of certain degrees of chronicity and severity. They also point out that in most cases of cholelithiasis with hydrops and cystic duct obstruction calcium carbonate stones are not formed. In support of their suggestion that the calcium carbonate is excreted by the mucous membrane of the gall bladder they point to the fact that the only other calculi containing so high a percentage of calcium carbonate are found occasionally in the salivary ducts and the pancreas, where there is also mucus secretion. In the October (13) 1931 *Annals of Surgery* they again review these cases. In the 7 cases reported they again emphasize that the cystic duct obstruction was always due to a gall stone of the cholesterol or cholesterol pigment variety. In our case, the obstruction was due to a stone of pure calcium carbonate. Phenister further states, that in his cases, the pre-existing stones seemed to have acted as a trigger for the precipitation of calcium carbonate. This stimulus to precipitation was absent in our case. The authors admit that there is no adequate explanation for the selective excretion of calcium carbonate by the gall bladder wall and suggest that conditions may be favorable only when the inflammation and obstruction are of certain degrees of severity and chronicity.

Lichtwitz and Bock quote researches of von Dochmann and Neumeister stating that when in dogs the cystic duct is closed, the bile

contains larger quantities of calcium and smaller amounts of sodium the longer this artificial stasis continues. Oliver asserts that as a result of the stagnation following the obstruction an absorption of alkaline substances occurs with the production of an acid bile. This leads to a catarrh with an outpouring of mucus in which the pigments and salts are precipitated. Wilkie's work on experimental cholecystitis in rabbits showed that cholesterol stones were formed if the cystic duct remained patent but that in cases in which the cystic duct was closed, the experimental cholecystitis produced either by intravenous or mural injections of streptococci gave rise to stones containing a high percentage of calcium.

Andrews and Hrdina were led to an investigation of the ability of the gall bladder to absorb calcium and instead of rabbits, dogs were employed as subjects. In short, their conclusions were the exact opposite of Wilkie's. In cases of cystic duct obstruction, gradual resorption of calcium occurs from the gall bladder and moreover this absorption occurs much more readily in the presence of suppuration.

Walsh and Ivy in their experiments on the fate of gall stones, observed the effects of ligation of the cystic duct of the dog's gall bladder and state that because of the pathological changes that followed ligation of the cystic duct with a stone in the gall bladder they decided to ascertain the effect of ligation of the duct alone. In 4 dogs the cystic duct was tied and the gall bladders examined 3 months later. In 1 the gall bladder wall had been replaced by fibrous tissue. In the others, the walls were thickened and abnormal. In each case, the viscous contained a colorless or light brown viscid secretion and small flecks or concretions of pigment and carbonates, the largest concretion weighing 0.184 grams. Robb found that obstruction of the cystic duct leads to distention and loss of function which in turn lead to atrophy of the mucosa, and in the muscular strata, to fibrous replacement. Stress, he averred, is the chief causal factor in the degeneration since only when stress overcomes function does calcification result.

DEDUCTIONS FROM STUDY

The consensus of opinion then, is in favor of the view that calcium in gall bladder bile appears in considerable quantities in the presence of inflammation. Yet Lichtwitz and Bock contend that calcium is present in bile in varying quantities and believe that when the calcium content of bile is high, calcium stones are formed. While a prolonged chronic inflammation may have been a factor in the case here presented we can not overlook the fact that a marked hypercalcaemia existed. In explanation of the unprecedented phenomenon of calcium precipitation without stone formation we may utilize the same physical law which Fowweather and Collinson employed in their explanation of pure cholesterol stone formation. They state that if crystallization of a substance occurs rapidly from a solution supersaturated with that substance, the crystals will be fairly pure and contain little of other material present in the solution. If however a suitable nucleus is originally present crystallization around the nucleus will



Fig. 1. Patient in erect posture. Observe the crescentic shadow just outside the pylorus.

begin to occur immediately the concentration of the bile exceeds the saturation value and will proceed comparatively slowly. Under such conditions the stone will contain besides the substances in which the solution is supersaturated considerable amounts of other substances present in the solution. In view of the hypercalcaemia present is it not possible that the bile in this case was supersaturated



Fig. 2

Fig. 2. Patient in prone position. Note the virtually oval shadow just outside the second portion of the duodenum.



Fig. 3

Fig. 3. Roentgenogram of the colon showing the shadow still present. Note also the presence of smaller shadow



Fig. 4

above it, which proved to be a calculus in the cyst duct.

Fig. 4. Flat plate which reveals the shadow at the dependent portion of which is a calculus. Observe also the persistence of the shadow



Fig. 5

Fig. 6

Fig. 7

Figs. 5 and 6. Roentgenograms of the gall bladder taken after excision. Note the shadow of the carbonate deposits in the dependent portion, also the cystic duct calculus.

Fig. 7. Roentgenogram of the contents of the gall bladder emptied into a test tube.

with calcium and that crystallization occurred at a time when no suitable nucleus for stone formation was present? It seems to us that the amorphous content of the precipitate found in our case hardly invalidates this hypothesis, since a change from the crystalline form might easily have occurred during its sojourn in the gall bladder.

We know for a certainty from the pathological examination that the mucous membrane of the gall bladder under consideration was completely destroyed. Whether this was brought about as a result of a previous damaging infection or prolonged intravesical tension or both the gall bladder wall's ability to absorb the bile elements was undoubtedly finally lost. Is it not possible that with the great excess of calcium, the other elements present in the bile could have been absorbed before final destruction of the mucous membrane was completed resulting in the retention of the residual non-absorbed calcium?

Another factor of importance that must be considered is that relating to the hydrogen ion concentration of the bile. As was observed above the normally alkaline liver bile undergoes a change toward the acid side during its residence in the gall bladder increasing

progressively with the time of its stay in this organ. In this case while we neglected to test the reaction of the gall bladder contents, the presence of the carbonate precipitate proves that the medium in which it existed was alkaline or at least, neutral to litmus. This bears out the contention of Rous and his associates, that where the normal protecting acidifying function of the gall bladder is interfered with, calcium precipitation may occur. Cystic duct obstruction is met with so frequently in cases unaccompanied by calcium deposition that the possibility of the existence of a prohibiting factor is strongly suggested. Is it not possible that the difference in the hydrogen ion concentration is the determining factor? It is our intention to make further investigations along this line.

Ever since the publication of Naunyn's original work, most observers have contended that calcium is a secretory product of the inflamed gall bladder mucosa. Aschoff on the other hand believes that for the formation of a stone there must be present, besides infection, abnormal chemical combinations in the bile, dysfunction of the biliary system and stasis. We feel that the calcium precipitation in this particular instance is a form of stone formation. We have attempted to explain why precipitation and not stone formation occurred but we wish to emphasize that the factors necessary for stone formation namely chronic infection, stasis produced by cystic duct obstruction, abnormal chemical combinations as evidenced by the hypercalcemia, and altered function of the gall bladder wall as revealed by the pathological examination of the gall bladder and the abnormal reaction of the gall bladder contents were present in this case.

The return of the blood calcium to normal after operation remains unexplained. The precise sources of the calcium, the influences modifying its amount and the comparative rarity of its precipitation in pure form in the gall bladder are other problems that remain to be solved.

SUMMARY AND CONCLUSIONS

1. An unusual case of hydrops of the gall bladder which contained pure amorphous and

crystalline calcium carbonate without stones but which was associated with cystic duct obstruction due to a stone of the same composition and was accompanied by a hypercalcaemia is here presented.

2 The roentgenological studies revealed a shadow in the region of the gall bladder which shifted its position and changed its shape (crescentic and oval). We believe that a demonstration of such shadows by X ray is strong evidence in favor of a highly concentrated calcium sediment.

3 We believe with Phemister that cystic duct obstruction is a constant factor that accompanies increased calcium content of the gall bladder. This factor is present whether the wall of the gall bladder is the seat of calcification or when the viscous contains pure calcium stones, calcium "soaps" or, as in our case, pure calcium precipitate. While in Phemister's cases the cystic duct obstruction when due to a stone was always due to one of the cholesterol or cholesterol pigment variety that in our case was caused by a friable calculus composed of the same material as that present in the gall bladder. It should be pointed out that in one of the cases reviewed by this author the obstruction was not calculous, but carcinomatous in nature.

4 The factors recognized as being necessary for stone formation as laid down by Aschoff were present in this case and we believe that this is a type of stone formation.

5 Some of the factors operative in this case as in all cases of gall stone formation, particularly calcium stone formation remain unsolved.

We wish to express our gratitude to Dr. M. F. Goldsmith, roentgenologist of the Montefiore Hospital, for the X ray interpretations; to Dr. Krikor Yerdumian, pathologist of the same institution for his pathological and analytical reports; also to Dr. M. A. Goodstone for his kindness in translating foreign literature and to Dr. M. A. Hershenson, for his splendid photographic reproductions.

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GASTRITIS AND DUODENITIS IN RELATION TO THE ULCER PROBLEM

A STUDY OF 124 CASES OF PARTIAL GASTRECTOMY

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THE basic cause of ulcer of the stomach, duodenum and jejunum is still the subject of debate. The problem has been attacked from various angles. Many theories and hypotheses have been advanced to explain the occurrence and life history of these lesions. The earlier investigators concentrated upon the pathological and clinical aspects of the ulcer itself. Changes in the gross and microscopic appearance of the adjoining mucosa were at first believed secondary to the ulcer itself. The pathological studies were, until recently, confined to autopsy material and were unsatisfactory in accurate histological detail because of the rapidity with which autolytic changes occur in the gastro-intestinal tract. Particularly, was this so of the rest of the stomach and duodenum in cases of ulcer. When however the operation of radical resection was adopted as the procedure of choice in European clinics the opportunity presented to fix the specimen promptly and to study material free of the artefacts due to autolysis. In many instances gross lesions of the mucosa were seen which were not detectable by external inspection and palpation of

the specimen. Histological evidence of diffuse changes in the mucosa were found however in all specimens even when no abnormalities were observed in the fresh state.

The operation of partial gastrectomy and subtotal gastrectomy has been employed, since 1923 in the surgical treatment of ulcer upon the service of Dr. A. A. Berg. The present study is based upon 124 specimens from cases in which this operation was performed upon patients with the clinical diagnosis of ulcer (68 ward patients, 56 private patients). The specimen was promptly opened along the greater curvature, pinned out and submerged in the fixing agent (Bouin's fluid). The next day blocks of tissue were removed as shown in Figure 1. Several sections were cut and stained from each block of tissue.

To make clear the significance of our findings, one should bear in mind the anatomy and histology of the normal stomach and duodenum. Such material to be satisfactory for microscopic study must be procured and fixed promptly after death. The study of Paschke and Orator and the modern text books of normal histology form the basis of the following description. As indicated in Figure 2 we distinguish certain areas of the stomach namely cardia, fundus, antrum and pylorus.

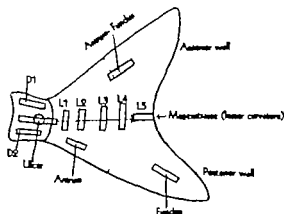


Fig. 1. Diagram showing locations from which blocks were taken.

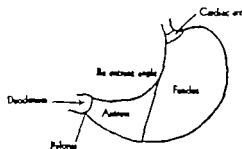


Fig. 2. Areas in the stomach as distinguished by the author.



Fig. 3. Lx Pseudopyloric transformation in case of gastric ulcer. X90



Fig. 4. Same section showing polynuclear leucocytic infiltration. X300.

At the junction of esophagus and stomach, the squamous epithelium of the former ceases rather abruptly and is replaced by columnar epithelium which lines the gastric mucosal surface. Opening by crypts or pits lined by similar cells are the cardiac glands, compound tubular structures which secrete mucin. They may be entirely absent, or occupy a zone of 5 to 10 millimeters. At times patches of gastric mucosa occur in the lower esophagus and tubular glands like those of the fundus

may be present. The fundus area presents normally a uniform type of mucosa. The surface and crypts are lined by columnar epithelium which produces mucin and forms a zone comprising 20 to 30 per cent of the mucosal thickness. Into the crypts empty the simple tubular or branched glands arranged parallel to each other and made up largely of two types of cells: (1) the granular zymogenic, or chief cells which produce pepsinogen, and (2) the spherical parietal or acid cells which



Fig. 5. Lx Case of gastric ulcer with multiple erosions in various stages. Section shows atrophic gastritis, acute inflammation, renewed erosion at the right.



Fig. 6. Same case of gastric ulcer as shown in Figure 5. Acute inflammation with erosion in fundus mucosa.

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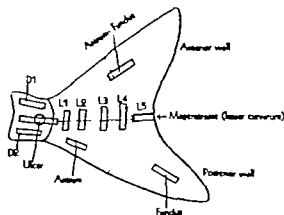


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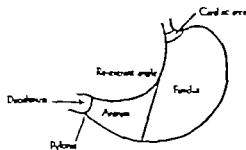


Fig. 2. Areas in the stomach as distinguished by the author.



Fig. 9. Case of ulcerous gastritis. X30.

found in the fundal mucosa especially in cases of gastric ulcer

Extensive inflammatory processes may be suspected when perigastric adhesions, congestion, edema, and increased vascularity are noted at the operating table but in most cases macroscopic changes are seen only when the specimen has been opened. These consist in the acute cases, of a diffuse or patchy redness and thickening of the mucosa. Small superficial or deeper mucosal defects varying in size from a pinhead to a centimeter in diameter so called erosions may be present. They are usually surrounded by a zone of intense erythema may be covered by exudate, and are usually found in the antrum, especially along the lesser curvature, rarely in the fundal mucosa. In a few instances (6 of our series) large irregular serpiginous or geographical areas of erosion are found which are classified as cases of ulcerous gastritis first described by Nauwerck. In these specimens the involvement of the submucous muscular and serosal coats is so marked that the operator suspects malignancy. It should be emphasized however that erosions may be discoverable only by microscopic examination of the specimen, especially in this the case in the duodenum. Frequently they are observed in the immediate neighborhood of the gross ulcer which ap-



Fig. 10. Gross specimen. Case of multiple duodenal ulcers, acute gastritis with macroscopic erosions.

pears to form by a conglomeration or fusion of erosions, and then by extension deeper into the gastric or duodenal wall. Here it is necessary to point out that a somewhat arbitrary differentiation is made between an erosion and an ulcer in that the latter term is used only when the mucous membrane defect has penetrated and disrupted the muscularis mucosa.

In other specimens these acute lesions are absent or minimal but the mucosa is hypertrophic, thickened and papillary or velvety in appearance. These changes may be so marked as to produce a polypoid appearance not only of the antral but of the fundal mucosa as well the *etat mamelonnee* of French authors. In still others, atrophic, fibrotic changes have taken place causing the mucosa to be reduced in thickness, pale, and smooth. Alternating areas of hypertrophy and atrophy may be seen in still other specimens. These are the cases of chronic gastritis and duodenitis. On microscopic examination however evidences of recurrent acute inflammatory foci are frequently observed healed erosions and recurrent or renewed erosion of healed lesions indicating that the acute inflammatory process although resolving is not wholly spent.

The microscopic changes of gastritis and duodenitis involve all the structures of the mucous membrane. In acute lesions the lamina propria or interstitial tissue is greatly increased throughout by increased capillary ap-

Fig. 11. Healed duodenal erosion. $\times 35$

vascularity and by enormous numbers of cells both within and around them, between the gastric pits and between the glandular elements. These cells consist almost entirely of polymorphonuclear leucocytes with few remaining lymphocytes, plasma cells, and eosinophils. The leucocytes are also seen in the lumen of the glands and the collecting tubules or pits and are found wandering through between the epithelial cells of these structures and of the surface. Thus an inflammatory exudate pours out of the stroma toward the lumen of the stomach and duodenum. The most intense manifestation of this process is seen in the papillae (*Leitenspitze*). At the apex of the papillae and in the depth of the crypts, epithelial defects are observed from which the exudate oozes forth in a fan shaped manner like a smoke screen. The epithelial cells themselves contain leucocytes within vacuoles. This invasion probably precedes the disappearance of the epithelial cells which results in erosions (*Leitenspitze Erosionen*). The cellular infiltration involves the muscularis mucosae submucosa and even the muscularis and serosa. In these structures it is more usual to find round cells predominant, collected about the capillaries and in lymphatic spaces. The proportion of polynuclear leucocytes to round cells in the stroma is the



Fig. 12. Healed duodenal ulcer with renewed erosion

basis for grading which we have adopted: thus grades 4 and 3 are acute gastritis lesions, grades 2 and 1 subacute. As already stated, foci of acute inflammation may be found in the chronic hypertrophic and atrophic forms. Erosions are usually found in the grade 3 and 4 cases. They may be very numerous and only microscopic in size or fewer in number larger and deeper extending to the muscularis mucosae or in some instances down to the lymphoid follicles resting upon the latter the so called follicular erosions. The larger erosions seem to form by fusion of neighboring smaller ones and by progressive destruction of the underlying stroma and glandular structures. By fusion of larger erosions the serpiginous lesions of ulcerous gastritis may be explained. Open capillaries in these erosions cause a seepage of blood into the stomach or duodenum and account for the massive hemorrhages which occur in these cases without any true ulcer being present. If the process continues the muscularis mucosae may be invaded and broken and an acute ulcer results. The rôle which the acid gastric secretions play in the progress of these lesions is still debatable. Komjetany believes that since no evidence of anæmic necrosis or hemorrhagic infarction has been found in these areas a vascular origin can be excluded, nor does he believe that the gastric juice is a factor. In this respect he differs from Hauser and Buechner who ascribe an important contributory rôle to peptic digestion.

That erosions can heal with subsidence of the acute process there is no doubt. In speci-

TABLE I.—SUMMARY OF SPECIMENS STUDIED

| | | Ward patients | Private patients |
|--|-----|---------------|------------------|
| Gastric ulcer | 14 | 7 | 7 |
| Duodenal ulcer | 70 | 48 | 22 |
| Gastritis and duodenitis (no true ulcer) | 11 | 4 | 7 |
| Ulcerous gastritis | 4 | 2 | 2 |
| Secondary cases | 5 | 14 | 1 |
| | 124 | 65 | 36 |

TABLE II.—FOURTEEN GASTRIC ULCER SPECIMENS

| | Cases |
|--|-------|
| Location of ulcer | |
| Juxtacardial | 3 |
| Re-entrant angle | 10 |
| Prepyloric | 1 |
| Type of mucosa in which proximal line of resection passed at lesser curvature. | |
| Esophageal | 1 |
| Fundal | 6 |
| Transitional | 1 |
| Antral | 6 |

| | No lesion | No specimens | Chronic hypertrophic | Acute and subacute graded | | | | Erosions |
|------------|-----------|--------------|----------------------|---------------------------|----|-----|----|----------|
| | | | | I | II | III | IV | |
| Gastritis | | | | | | | | |
| Antral | | | 1 | 0 | 3 | 6 | 4 | 7 |
| Fundal | 1 | 1 | | 2 | 6 | 2 | 0 | |
| Duodenitis | | 2 | 6 | 4 | 1 | 1 | 0 | 1 |

Ulcerous gastritis present in specimens

TABLE III.—SEVENTY DUODENAL ULCER SPECIMENS

| | Cases |
|--|-------|
| Single ulcer | 41 |
| Multiple ulcers | 29 |
| Type of mucosa in which proximal line of resection passed at lesser curvature. | |
| Fundal | 57 |
| Transitional | 8 |
| Antral | 5 |

| | No lesion | No specimens | Chronic hypertrophic | Chronic atrophic | Acute and subacute graded | | | | Erosions |
|------------|-----------|--------------|----------------------|------------------|---------------------------|----|-----|----|----------|
| | | | | | I | II | III | IV | |
| Gastritis | | | | | | | | | |
| Antral | | | 8 | 8 | 1 | 15 | 15 | 3 | 0 |
| Fundal | 14 | 1 | 6 | 1 | 17 | 1 | 1 | 0 | 0 |
| Duodenitis | | 3 | 1 | | 0 | 9 | 14 | 11 | 40 |

mens of subacute and chronic gastritis and duodenitis the growth of epithelium from neighboring surface and gland cells is observed progressing from the borders of the defects over the granulation tissue. In other lesions complete epithelization has occurred, a single layer of cuboidal cells covering the granulation and connective tissue which still

contains polynuclear leucocytes. In the vicinity of these healing and healed erosions one notes cystic dilatation of the glands, replacement of the deeper glandular structures by granulation, and scar tissue. A remarkable change in the surface and crypt epithelium is also observed, the so called pseudopyloric transformation characterized

TABLE IV—ELEVEN GASTRITIS AND DUODENITIS SPECIMENS, WITHOUT TRUE ULCER

| | |
|--|-------|
| Type of mucosa in which proximal line of resection passed at lesser curvature. | Cases |
| Fundal | 8 |
| Transitional | 1 |
| Antral | 2 |

| | No lesion | Doubtful | Chronic hypertrophic | Chronic atrophic | Acute and subacute graded | | | | Erosions |
|------------|-----------|----------|----------------------|------------------|---------------------------|----|-----|----|----------|
| | | | | | I | II | III | IV | |
| Gastritis | | | | | | | | | |
| Antral | | | | | | 3 | | | 5 |
| Fundal | | | | | 2 | | | | |
| Duodenitis | | | | | | | | 1 | 6 |

TABLE V—TWENTY FIVE SECONDARY CASES

| Previous operation | Predominant lesion | | | | |
|------------------------------------|--------------------|----------------|--------------------------|---------------|----------------|
| | Gastric ulcer | Duodenal ulcer | Gastritis and duodenitis | Jejunal ulcer | Marginal ulcer |
| Gastro-enterostomy | 4 | | 4 | 1 | 3 |
| Pyloroplasty | | | | | |
| Pylorocomy | | | | | |
| Partial gastrectomy (overduodenum) | | | | | |
| Stoma of perforation | | | | | |

* Includes one with previous pyloroplasty.
Also had duodenal ulcer.

by goblet cells and at times even Paneth cells a type of epithelium resembling that of the intestine.

In these areas particularly do evidences of persistent inflammation or renewed inflammation with polynuclear leucocytic infiltration and renewed erosions appear. Such areas are commonly found in the antral zone rarely in the fundal mucosa. In some cases the antral mucosa is almost entirely replaced by this type of mucus secreting goblet cell epithelium. As the inflammatory process resolves the stroma decreases in amount and the polynuclear leucocytes are replaced by plasma cells and lymphocytes.

Recrudescences of acute inflammation renewed erosions, healing scarring and metaplasia may go on repeatedly in such diseased mucous membranes terminating in extensive atrophic changes. The inflammatory process commonly involves the antral and duodenal mucosa but the fundal mucosa does not entirely escape although here the frequency and intensity of the process is found to be much less.

DISTRIBUTION OF THE LESIONS

The findings in our surgical material correspond qualitatively with those observed by the European contributors such as Kallima, Orator Puhl, Konjetzny and others. Analysis of our findings is presented in the appended tables grouping the cases and summarizing the pathological lesions. Konjetzny states that, in one hundred consecutive cases studied by Puhl, isolated erosions were seen macroscopically in 80 per cent, and lesions of ulcerous gastritis and duodenitis in 45 per cent.

In our material, erosions were recognizable macroscopically in 32 cases, and serpiginous ulcerous gastritis was observed in 6 additional cases, about 30 per cent in all. Other gross evidences of gastritis and duodenitis were apparent in an additional 35 specimens. Microscopic erosions were found in 79 instances, about 64 per cent of the 124 specimens. Of 14 gastric ulcer cases, they were present in 7 of 70 duodenal ulcer cases, we found them in 45 in 11 specimens with no true ulcer erosions were seen in 9 in 25 secondary cases, they occurred in 14. Their distribution in the

TABLE VI.—TWENTY FIVE SPECIMENS OF SECONDARY CASES

Case
Type of mucosa in which proximal line of resection
passed at lesser curvature.
Fundal 18
Transitional 8
Antral 5

| | No lesions | No specimens | Chronic hypertrophic | Chronic atrophic | Acute and subacute graded | | | | Erosions |
|------------|---------------|-----------------|-------------------------|---------------------|---------------------------|----|-----|----|----------|
| | | | | | I | II | III | IV | |
| Gastritis | | | | | | | | | |
| Antral | | | 6 | 4 | 0 | 1 | 3 | 8 | 0 |
| Fundal | 5 | | 2 | 1 | 13 | 1 | 2 | 0 | 0 |
| Duodenitis | | 1 | 1 | 1 | 2 | 1 | 1 | 6 | 2 |

| Previous operation | Antral erosions | Duodenal erosions |
|-----------------------|-----------------|-------------------|
| Gastro-enterostomy 14 | 5 | 4 |
| Pyloroplasty 3 | 0 | 1 |
| Pylorotomy 3 | 2 | 0 |
| Partial gastrectomy 1 | 1 | 0 |
| Severe perforation 4 | 1 | 3 |

three mucosal zones is indicated in the tables

It is evident that the frequency of erosions both on gross and microscopic examination, and the intensity of the inflammatory process is considerably less in our series of specimens than in those reported by European investigators. We believe this is due to the fact that most of our patients are on a strict Sippy regimen for periods of 1 to 3 weeks prior to operation and that this treatment is conducive to resolution of the inflammatory process and healing of erosions. In European clinics one notes much less co-operation between medical and surgical departments than obtains in our own hospitals with the result that ulcer patients admitted directly to the surgical clinic with active symptoms are usually operated upon without the preliminary medical management which we are accustomed to employ. Konjetzny himself observed that preliminary medical treatment of these patients tends to disappearance of the acute and subacute inflammatory process in the mucosa.

RELATIONSHIP OF GASTRITIS AND DUODENITIS TO ULCER

We realize the limitations of purely morphological studies without experimental re

production of the lesions when applied to the problem of the etiological relationship of the inflammatory changes described to acute and chronic ulcers of the stomach, duodenum, and jejunum. Certain deductions however, are permissible when the findings and clinical data are analyzed. Of first importance is that group of cases with the typical symptoms of ulcer characterized by periodic pain, remissions and bouts of active bleeding patients in whom the operative specimen reveals no true ulcer but definite evidence of acute gastritis and duodenitis with erosions. It is this type of case in which X ray examination, usually made when the acute symptoms have subsided, is entirely negative and in which exploration frequently reveals so little or no pathology on inspection and palpation that the surgeon finds no indication for any surgical procedure. Even pyloroduodenotomy and inspection may reveal no recognizable lesion yet at a subsequent time a typical ulcer may develop and be removed surgically. These are the cases which have been described as "essential haematemesis" or gastrostaxis. In discussing the healing of ulcers and their life cycle, Crohn stated that an acute ulcer had been present but healed before exploration was undertaken. If one

remembers, however that the inflammatory lesions and erosions may be recognizable only by microscopic section that they may be distributed beyond the range of inspection possible through the usual exploratory incision and moreover may have partly resolved under preliminary medical management the explanation of these cases upon the basis of an acute pre-ulcer gastritis and duodenitis seems more probable.

The similarity of erosions to the acute ulcer their variation in size and depth and their apparent progressive nature leads us to believe that the erosion is the precursor of the typical acute ulcer. We have seen moreover that erosions may heal and break down again and that healed ulcers may present renewed erosions favoring recurrence. In the stomach and duodenum in which ulcer has occurred and healed, new ulcers may form as a result of renewed inflammation and erosion.

The factors, however which determine the development and persistence of the chronic callous ulcer and operate to prevent or hinder its healing are not well understood. Mechanical and vascular causes have been invoked but do not entirely satisfy us. That a chronic ulcer advances eccentrically by erosions forming in the mucosa at its edge our specimens give ample evidence. That ser-piginous ulcerous gastritis develops in a similar manner also seems probable. In cases of chronic callous ulcer subsidence of the gastritis and duodenitis to a chronic hypertrophic or even atrophic stage occurs frequently but such mucous membranes are liable to renewal of the acute inflammatory processes. The rapid relief of pain in the patient with a callous ulcer after a short period of strict dietetic management is explainable by the subsidence of the associated gastritis the ulcer itself being relatively unaffected and much slower to respond to treatment by evidence of healing.

In view of the constant association of gastritis and duodenitis in the ulcer stomach, and the evidence that this process passes through an acute, subacute, and chronic phase with recurrences, it seems likely that the so called life cycle of ulcer is dependent upon the life cycle of gastritis and duodenitis, and that only if a healed stage of the latter is attained,

is permanent healing of the ulcer and freedom from new ulcers possible. In the case of callous ulcer however, healing of the lesion may not occur despite the subsidence of gastritis to a chronic or even atrophic stage.

On the other hand, that gastritis and duodenitis may go on with periodic recurrence of symptoms simulating renewed ulceration or with actual renewed ulceration after medical management and various conservative surgical procedures performed for the cure of the original ulcer with apparent success, is supported by the findings in the secondary cases (Tables V and VI). That jejunal ulcer may occur even after radical resection is certain, but the factors responsible for this occasional failure require careful investigation.

CONCLUSIONS

We believe that the following conclusions may be accepted on the basis of present knowledge.

1. Ulcer does not occur in a normal gastric or duodenal mucous membrane.

2. Gastritis and duodenitis precede the development of ulcer and predispose to it.

3. Gastritis and duodenitis is a disease process which passes through acute, subacute, and chronic stages with recurrences. True ulcer may not develop but when it does, is a phase of the process.

4. The factors responsible for the development and persistence of the chronic callous ulcer are not well understood.

5. Ulcers may heal spontaneously or as a result of treatment or surgery but the underlying gastritis and duodenitis may persist and predispose to renewed ulceration.

6. The etiology of gastritis and duodenitis of the type which we believe precedes ulcer is not known. Whether this type of gastritis and duodenitis is specific is still an open question and similar studies in other gastric lesions are in progress. Unfortunately post mortem material is usually of no value for the detailed histological study necessary for morphological investigation. Determination of the etiological factor or factors in gastritis and duodenitis seems to us a necessary precursor to discovery of the basic cause of ulcer.

PLACENTA ACCRETA

A REVIEW OF THE LITERATURE AND THE REPORT OF TWO PERSONAL CASES

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PLACENTA accreta, although a very rare condition, was known to the older obstetricians and referred to under the name of adherent placenta Morgagni, Tarnier and Budin, according to Reeb, mentioned the condition and stated that it was difficult, even with the bistoury, to separate the placental tissue from the uterine muscle.

The most conspicuous elements of the placenta are the villi and the intervillous spaces, for they make the greater bulk of the organ. The decidua basalis or serotina the maternal portion of the placenta, is found beneath the villi and is penetrated by them in some places. In the decidua basalis, which is made up largely of decidual cells—modified stroma cells of the endometrium—may be found blood vessels, uterine glands, and in its superficial portions, fetal ectoderm mingled with the decidual cells. The membrane of Nitabuch a dense fibrinoid structure composed largely of necrotic chorionic epithelium is found along the muscle border, in proximity to the villi. The villi and the adjoining smooth muscle cells may sometimes be involved in the necrotic layer. Under normal conditions the basal decidua is interposed throughout between the villi and the uterine musculature. This has a profound significance since it is responsible for the separation of the placenta, the ragged torn surface of which has become split off and remains adherent to the villi.

The normal separation of the placenta is facilitated by the spongy decidual layer. Following the expulsion of the fetus, the venous spaces fill with blood and as the contractions and relaxations of the musculature continue, separation occurs. If this layer is absent, it becomes obvious that the separation will be more difficult. The partial or complete absence of decidua compacta will make the separation even more difficult. If the chorionic villi are in direct contact and penetrate into the muscle layer separation will be found un-

possible without tearing portions of the myometrium. In the presence of only a thin layer of decidua compacta or in the absence of it, we speak of placenta accreta vera. If the chorionic villi penetrate into the muscle layers the condition of placenta increta results. The term placenta accreta, as found in the literature, is applied to both pathological defects. From these basic anatomical considerations it is obvious that the clinical course will be influenced by the extent of the chorionic invasion. In association with accreta there are only a few statements made in the literature concerning the decidua vera and all of them report defective development rather than hypertrophy.

The differentiation of accreta from the so called adherent placenta, which is due to a disturbance in the mechanism of separation, offers no great difficulty. In the former with the gloved hand in the uterus no line of cleavage between the placenta and the uterine wall can be found, thus making removal impossible, while the line of cleavage is always found and manual removal is not as a rule very difficult in the latter. The condition of adherent placenta might be encountered when the organ is large and thinned out or when implantation has occurred in a uterine horn.

Clinically when the placenta, after separation, is retained in the birth canal one notices bleeding descent of the cord, and a round, firm fundus which has risen to a higher level than it occupied immediately after the expulsion of the fetus. If on the other hand, the placenta is adherent and has not separated from the uterine wall, one finds no bleeding from the site of placental implantation, no descent of the cord, and intermittent uterine contractions are felt. It is a striking clinical phenomenon that placenta accreta is not associated with severe loss of blood, until the operator begins an attempt at separation of the placenta.

Adherent placenta is usually partial and accompanied by severe hemorrhage.

Placenta accreta has been reported to occur from the third month of pregnancy to full term

ETIOLOGY

Three factors are usually responsible for this anomaly according to the studies of Kwartin and Adler

1 Maldevelopment of the uterus with hypoplasia of the endometrium and destructive changes of the properly developed endometrium

2 Excessive growth of the chorionic elements.

3 Insufficient antiferment production against the erosive power of the trophoblast, possibly due to deficiency of the hormonal cycle of the maternal organism. This point, however needs further study and elaboration

The causes may be summarized as (a) manual removal of the placenta in one or more previous pregnancies with resulting damage to the endometrium (b) the performance of vigorous or repeated curettages (c) medication of a destructive and erosive type or vaporization employed in the uterus (d) the presence of submucous myomata with consequent atrophy of the overlying mucosa (e) the use of the old practice of steaming the uterus (f) affections of the endometrium, such as endometritis, septic puerperal processes pyometra (g) faulty position of the placenta, placenta previa (h) pregnancy in a uterine diverticulum

INCIDENCE

Berry Hart in 1889 and Hofmeier in 1890 published the first observations with histological examinations. Since then a review of the literature gives the following figures

| | |
|--------------|-----------------------------|
| Blagoderow | 1 case in 13,000 deliveries |
| Forster | 1 case in 7,000 deliveries |
| Hirst, B. C. | 1 case in 40,000 deliveries |
| Jackson. | 1 case in 8,000 deliveries |
| Klafter | 1 case in 14,000 deliveries |
| Kruel | 1 case in 30,000 deliveries |
| Leopold | 1 case in 10,000 deliveries |
| Nathanson | 1 case in 20,000 deliveries |
| Polak | 1 case in 6,000 deliveries |
| Stoeckel | 1 case in 8,273 deliveries |

An average of one case in 4,622 deliveries.

STATISTICS

The literature on placenta accreta consists almost entirely of case reports. In many instances this pathological entity is confused with adherent placenta. I have included in my report only those cases which had histological study and in a few occasions postmortem and clinical study which left no doubt that the placenta had grown directly in the uterine musculature.

E. Francols' quotes Troussot's published 10 cases of adherent placenta in women who had previously been curetted 5 of these were premature deliveries. One of the 10 patients, Jacobs, had a hysterectomy with recovery and the report says "The anatomic specimen showed the intimate connection existing between the placenta and the uterine walls." No histopathology was given however. He further reported 6 cases from the Banelocque clinic where the placenta was delivered by morcellation but here again no microscopic study was mentioned. I have grouped the 83 collected cases under four heads, namely those treated by manual extraction those treated by abdominal hysterectomy those treated by vaginal hysterectomy and one case treated by cesarean section

MATERNAL MORTALITY IN PLACENTA ACCRETA

In the series of 36 cases treated by manual extraction 16 mothers died and 10 recovered a mortality of 72.2 per cent. The women who recovered probably had partial placenta accreta, although this point is not stated, for it seems almost unbelievable that one could separate an entire placenta from the uterine musculature without tearing the uterus and without severe hemorrhage and sepsis, the complications to be feared and which usually result in death when this method is persisted in

Abdominal hysterectomy gave 32 recoveries and 2 deaths in a group of 34 cases, a mortality of 5.8 per cent. In one instance the cause of death was not stated in the other it was peritonitis, the patient dying on the eighth postpartum day. From the standpoint of results this method stands out as the rational one and

TABLE I.—PLACENTA ACCRETA TREATED BY MANUAL EXTRACTION

| No. | Author | Fate M C | Complication | Operation |
|-----|---------------------------------------|---------------------|--|-----------------------------|
| 1 | Ahlfeld (1) | D D | Perforation of peritoneum | |
| 2 | Anderson (2) | D | | |
| 3 | Andrews (6) | L D | Placenta removed placental. No histopathology Clinically accreta | |
| 4 | Balsch (7) | | | |
| 5 | Bauerstein (8) | D L | Embolism | |
| 6 | Cooper (3) | L L | Placenta removed placental. No histopathology Clinically accreta | |
| 7 | Dietrich (14) | D D | Rupture of uterus | |
| 8 | Dorsett (15) | L D | Sepsis. Pelvic cellulitis and pelvic abscess | Manual extraction placental |
| 9 | Freund-Hiltschmann (19) | L D s mon. | | Detachment of placenta |
| | Goethals, quoted by Jackson (21) | L L | Inversion of uterus | Manual extraction |
| 11 | Hense (22) | D L | | |
| | Illak (23) | D | Placenta previa | |
| 13 | Holmes (24) | D | | |
| 14 | Jackson (27) | L L | One-third of placenta adherent to posterior wall of uterus | Manual extraction |
| 15 | Kellogg, quoted by Jackson (30) | D | Cervix torn deeply on right side. Post-mortem diagnosis | Manual extraction |
| 16 | Kwostanaky (16) | D L | | |
| 17 | Labhardt (37) | L | Diverticulum | |
| 18 | Lehmann (38) | D L | Diverticulum and rupture of uterus | |
| 19 | Leopold-Lehne (39) | D L | | |
| 20 | Martin, E. (40) | D D | | |
| 21 | Meyer-Kuegg (42) | D L | | |
| | Neumann, Julius (43) | D L | Placenta previa | |
| 23 | Northman (45) | L L | | |
| 24 | Polak and Phelan (48) | D | Excessive hemorrhage | |
| 25 | Polak and Phelan (48) | D | Sepsis | Manual extraction placental |
| 26 | Polak and Phelan (48) | D | Sepsis | Manual extraction placental |
| 27 | Schmidt (51) | D | Placenta previa | |
| 28 | Schmidt (51) | D | Placenta previa | |
| 29 | Schwitzer (54) | D D | Placenta previa | |
| 30 | Schwitzer (55) | | | |
| 31 | Schwedenner (56) | D D | Ruptured uterus | |
| 32 | Schwerner (57) | D L | Placenta left in uterus 12 days. Died on 21st day | |
| 33 | Stebbins (58) | D D Abortion | Two-thirds of placenta grown in non-cervix | |
| 34 | Tenant Wilson and Craig-Sullivan (61) | D D s mon. preg. | Post-mortem placenta adherent to vault of uterus | |
| 35 | Vest (63) | D | | |
| 36 | Wilson (66) | D | Died 17th day Gangrene of uterus | Manual extraction placental |

Fate M—Mother C—Child L—Lived. D—Died.

TABLE II.—PLACENTA ACCRETA TREATED BY ABDOMINAL HYSTERECTOMY

| No. | Author | Fate M C | Complication | Operation |
|-----|------------------------------------|-------------------|---|------------------------------|
| | Abrams, Bus, quoted by Donsett () | D L | Purpura Died eighth day postpartum | Hysterectomy type not stated |
| | Alexandrov (4) | L D | Ruptured uterus | Abdominal hysterectomy |
| 3 | Allrecht (4) | L D | | Total extirpation |
| | Baumgart and Busch (4) | L D | | Supravaginal amputation |
| 5 | Bogdanow (16) | L Mac | | Hysterectomy type not stated |
| 6 | Bortlewitz () | D | | Supravaginal amputation |
| 7 | Bortlewitz () | L D | Ruptured uterus | Total extirpation |
| 8 | Brower () | L L | | Pars |
| 9 | Donsett (2) | L L | | Supravaginal amputation |
| 10 | Fischer (7) | L D Mac | | Supravaginal amputation |
| | Fischer (18) | L D | | Hysterectomy type not stated |
| | Gelfert (20) | L D 5 mm prog | | Total extirpation |
| 13 | Hebbach (2) | L L | Diverticulum of uterus | Supravaginal amputation |
| 14 | Irring, quoted by Jackson (26) | L | | Supravaginal amputation |
| 15 | Jackson (7) | L L | | Supravaginal amputation |
| 16 | Jacobson (28) | L L | Aloof of uterus | Pars |
| 17 | Kabanow (29) | L L | Placenta had forced its way through uterine wall and cervix | Pars |
| 18 | Kellom, quoted by Jackson (26) | L | Endometrium myoma | Supravaginal amputation |
| 19 | Klostermann (3) | L L | | Supravaginal amputation |
| 20 | Kratzschel (11) | L D | Ruptured uterus | Supravaginal amputation |
| 21 | Kwartin and Adler (12) | L L | | Pars |
| 22 | Meyer R (41) | L | | Total extirpation |
| 23 | Mithrasen (42) | L L | | Hysterectomy type not stated |
| 24 | Musmann, H O (44) | L L | Total placenta previa | Hysterectomy type not stated |
| 25 | Piccoli (47) | L L | | Hysterectomy type not stated |
| 26 | Piccoli (47) | L L Termin | | Hysterectomy type not stated |
| 27 | Polak and Polak (48) | L D 7 mm mac | | Supravaginal amputation |
| 28 | Preiner and Olmsted (49) | L L | Clinical diagnosis, no histopathology | Supravaginal amputation |
| 29 | Roth (30) | L L | | Pars |
| 30 | Schwarzbach (13) | L | Endometrium myoma | Supravaginal amputation |
| 31 | Stephan (39) | L | | Supravaginal amputation |
| 32 | Tenny (36) | L D 6 mm prog. | | Hysterectomy type not stated |
| 33 | Thomayer (41) | L L | | Supravaginal amputation |
| 34 | Wagalla (54) | L | | Supravaginal amputation |

*Fate M—Mother C—Child, L—Lived, D—Dead

is advocated by all recent writers on the subject. The mortality is about that of a hysterectomy on a puerperal uterus. In the vaginal hysterectomy group there were 11

cases, 7 mothers recovered and 4 died, a mortality of 36.3 per cent, which is still a considerable improvement over the removal by morcellation. There was one mother treated

TABLE III—PLACENTA ACCRETA TREATED BY VAGINAL HYSTERECTOMY

| No. | Author | Fate M C | Complication | Operation |
|-----|------------------|---------------------|--------------------------|---|
| 1 | Ecke (16) | L L | Multiple myomata | Vaginal total extirpation |
| | Joschmovits (38) | L D 2 mos. preg. | | Vaginal total extirpation. Local anesthetic |
| 3 | Joschmovits (3) | L L | | Vaginal total extirpation |
| 4 | Klaftan (5) | L L | | Vaginal total extirpation |
| 5 | Klaftan (37) | L | Myoma of uterus | Vaginal total extirpation |
| 6 | Klaftan (37) | D | Sepsis | Vaginal total extirpation |
| 7 | Klaftan (37) | L L | | Vaginal total extirpation |
| 8 | Klaftan (37) | D D | Inversion of uterus | Vaginal total extirpation |
| 9 | Kraus (34) | L D | | Vaginal total extirpation |
| 10 | Mayer R. (42) | D L | Lateral placenta previa | Vaginal total extirpation |
| 11 | Wells (65) | D D | Cervical placenta previa | Vaginal total extirpation |

Fate: M—Mother C—Child, L—Lived, D—Died.

TABLE IV—PLACENTA ACCRETA TREATED BY CÆSAREAN SECTION

| No. | Author | Fate M C | Complication | Operation |
|-----|----------------------|-------------|--------------------------|------------------|
| 1 | Neubauer, H. O. (14) | L L | Cervical placenta previa | Cæsarean section |

Fate: M—Mother C—Child, L—Lived, D—Died.

by cæsarean section this was a case of partial accreta and the mother recovered

MANAGEMENT

In the presence of an adherent placenta sufficient time having elapsed since the delivery of the child and the usual methods of expression having failed, the patient should be anesthetized and the sterile gloved hand introduced in the uterus under the strictest asepsis. An attempt should be made to find a line of cleavage between the placenta and the uterine wall. If it is found that no cleavage exists and that the placenta tears away from the musculature, further attempts at extraction should be given up. The uterine cavity should be packed with gauze, if the uterine manipulations have started a hemorrhage and an abdominal supravaginal amputation of the uterus should be performed. Blood transfusions, before and after operation, should be administered as indicated by the patient's condition.

CASE REPORTS

CASE 1 Mrs. A. S. 38 years of age was first seen on November 14 1925 during the course of her

second pregnancy. Her family history was not remarkable her previous health had been good and her menstruation had been normal. The last period had occurred on April 6, 1925 had lasted 2 days and she had had a show of blood on May 11 1925. Her expected confinement had been figured for about January 13 1926. Her first pregnancy had evolved without complications and she was delivered, normally, on March 30 1915 of a normal infant, weighing nine pounds. The placental stage had presented no difficulties. A few hours after delivery she had a severe uterine hemorrhage which subsided after appropriate treatment. Two days later she had a second hemorrhage. She was given saline solution and rabbit serum to control the bleeding. Two consultants were called. A transfusion of 500 cubic centimeters of whole blood, which was obtained from the husband was performed. There was a severe reaction after the transfusion the patient was very pale and weak. Ten days after the birth she had a third hemorrhage. The obstetric consultant then packed the uterus with gauze. Recovery was very slow and was complicated by sepsis. Four weeks after delivery a septic thrombophlebitis of the left lower extremity developed and this was followed by the same process in the right lower extremity. She was in bed for 8 weeks and resumed her duties gradually. At the time of my examination, the patient was 7 months pregnant the uterus was large and rose eight fingers breadth above the umbilicus the fetal heart heard at the level of the umbilicus on the right side was strong and regular. There was

TABLE II.—PLACENTA ACCRETA TREATED BY ABDOMINAL HYSTERECTOMY

| No. | Author | Fate M C | Complication | Operation |
|-----|--|---------------------|---|------------------------------|
| | Alexander, Egan, quoted by Dorsett () | D L | Purulent. Died eighth day postpartum | Hysterectomy type not stated |
| | Alexander (4) | L D | Ruptured uterus | Abdominal hysterectomy |
| 3 | Alhaciet (3) | L D | | Total extirpation |
| 4 | Baumgart and Busch (4) | L D | | Supravaginal amputation |
| 5 | Engelbrecht (16) | L Mac. | | Hysterectomy type not stated |
| 6 | Borkenrich () | D | | Supravaginal amputation |
| 7 | Borkenrich () | L D | Ruptured uterus | Total extirpation |
| 8 | Brewer () | L L | | Pare |
| 9 | Dorsett (5) | L L | | Supravaginal amputation |
| 10 | Foster (7) | L D Mac | | Supravaginal amputation |
| | Farmer (8) | L D | | Hysterectomy type not stated |
| | Gelfert (10) | L D 1 not preg. | | Total extirpation |
| 13 | Halsbach (5) | L L | Divericulum of uterus | Supravaginal amputation |
| 14 | Irrving, quoted by Jackson (16) | L | | Supravaginal amputation |
| 15 | Jackson (17) | L L | | Supravaginal amputation |
| 16 | Jackson (18) | L L | Aloof of uterus | Pare |
| 17 | Kakaw (19) | L L | Placenta had forced its way through the uterine wall and serosa | Pare |
| 18 | Kelly, quoted by Jackson (16) | L | Subserous myoma | Supravaginal amputation |
| 19 | Klancorn (21) | L L | | Supravaginal amputation |
| 20 | Kratovich (22) | L D | Ruptured uterus | Supravaginal amputation |
| | Kurtz and Adler (23) | L L | | Pare |
| 22 | Mayer R (42) | L | | Total extirpation |
| 23 | Nathanson (43) | L L | | Hysterectomy type not stated |
| 24 | Neuman, H O (44) | L L | Total placenta previa | Hysterectomy type not stated |
| 25 | Piccoli (7) | L L | | Hysterectomy type not stated |
| 26 | Piccoli (7) | L L Tumor | | Hysterectomy type not stated |
| 27 | Polak and Pliska (45) | L D 7 mos. preg. | | Supravaginal amputation |
| 28 | Procter and Glascock (46) | L L | Clinical diagnosis, no histopathology | Supravaginal amputation |
| 29 | Reib (50) | L L | | Pare |
| 30 | Schwarzbach (51) | L | Subserous myoma | Supravaginal amputation |
| 31 | Sciphus (39) | L | | Supravaginal amputation |
| 32 | Sims (48) | L D 6 mos. preg. | | Hysterectomy type not stated |
| 33 | Thomsen (8) | L L | | Supravaginal amputation |
| 34 | Waples (41) | L | | Supravaginal amputation |

*Fate: M—Mother C—Child, L—Lived, D—Died.

is advocated by all recent writers on the subject. The mortality is about that of a hysterectomy on a puerperal uterus. In the vaginal hysterectomy group there were 11

cases, 7 mothers recovered and 4 died, a mortality of 36.3 per cent, which is still a considerable improvement over the removal by morcellation. There was one mother treated



Fig. 2. Case 2. Fresh thrombus in dilated vein. Necrosis and acute infectious inflammation in adjoining placental tissue. $\times 30$.

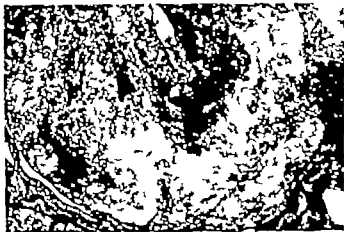


Fig. 3. Case 2. Hyaline decidua planted directly on myometrium. No mucosa present. Acute inflammation of infectious origin where villi and decidua join. $\times 40$.

on April 17, 1930. Her family history showed nothing remarkable. She had had scarlet fever as a child and pneumonia 10 years previously but otherwise had enjoyed good health. Her menstruation had been normal, her last period had occurred on November 25, 1929, had lasted 3 days and her expected confinement had been figured for about September 2, 1930. She had had two previous pregnancies; the first was terminated by the instrumental delivery of a large child who lived 2 hours, after 72 hours of labor; the second also instrumental was complicated by a retained placenta with probable manual extraction although the patient was not entirely clear on this point. During the current pregnancy she had edema of the feet and ankles; the urine examination showed the slightest possible trace of albumin, and the blood pressure was 110 systolic and 65 diastolic. The general physical examination revealed no abnormalities and the pelvic measurements were consistent with a just-minor pelvis.

She was admitted to the hospital on June 25, 1930, stated that she had lifted an ice box 3 days previously and that the following morning she had been seized with a sharp pain in the abdomen with the point of maximum intensity in the umbilical region. The pain lasted 2 days but there was no vaginal bleeding at any time. A diagnosis of contusion of the abdominal wall was made and the patient discharged to the prenatal clinic 48 hours after admission. She again entered the hospital on August 22; the membranes having ruptured spontaneously at 1:45 p.m. Labor began at 8 p.m. on August 23 and she was delivered at 1 p.m. on August 24. The vertex, which was presenting in right occipitoposterior position, was arrested in mid-pelvis. Under ether anesthesia the head was rotated manually, forceps were applied, and the simple extraction of a normal male infant followed. The placenta was said to be adherent but was expressed at 1:20 p.m. The perineum was intact and the placenta and membranes were reported to be complete. One cubic centimeter of

pitocin and 1 cubic centimeter of gynergen were injected in the thigh muscles. One hour postpartum the uterus was said to be firm and there was no undue bleeding. The lochia were serosanguineous throughout the puerperium. She was allowed out of bed on September 3 and discharged in good health on September 5, 12 days after delivery. The baby had done well and was discharged in good condition.

She was again admitted on September 15 after having had two moderate uterine hemorrhages. She was curetted by one of the visiting obstetricians and the uterus and vagina were firmly packed with iodoform gauze. The material removed was submitted to Dr. Frank B. Mallory and the following report was received: "Retained placental tissue, old chorionic villi, in places calcified." She was given shock treatment following the curettage. On September 19, the pack was removed in her bed; she had a violent hemorrhage and the uterus and vagina were again firmly packed with iodoform gauze.

I first saw her during the forenoon of September 20. She was anemic and in a state of shock. The hemoglobin was 50 per cent, the red blood cells 2,500,000 and the white blood cells 19,000. She was given a transfusion of 600 cubic centimeters of citrated blood from her husband and returned to bed in an improved condition. The next day, September 21, she was given a second transfusion of 600 cubic centimeters of citrated blood at the end of which she looked and felt much better. She was then prepared for a laparotomy. The iodoform pack had remained in the uterus and vagina.

Operation—Suprapubic hysterectomy. Double salpingo-oophorectomy. Vaginal and abdominal drainage. Under ether anesthesia the abdomen was opened by a median suprapubic incision 6 inches long. The bladder was separated from the uterus, the infundibulopelvic ligaments, the round ligaments, and the uterine vessels were cut between clamps. At this time the uterovaginal pack was removed and the cervix was amputated at the level



Fig 4. Case . . . Decidua and villi planted directly on the myometrium. No mucus present. $\times 35$



Fig 5. Case . . . At left, sclerosed blood vessel due to organization of thrombus. Hyaline layer of decidua seated directly on myometrium. Penetration of villi into blood sinus. $\times 40$.

of the internal os, thus removing the uterus suprapubically with the adnexa. The three vessels of each side were doubly ligated with No. 2 chromic catgut. The posterior lip of the cervix was split in the median line, the vagina was opened and an iodoform wick was introduced in the opening, one end of the wick being left in the peritoneal cavity. The anterior and posterior peritoneal layers were united with a running catgut suture around the wick. A cigarette drain was placed in the cul-de-sac of Douglas and allowed to come out at the inferior angle of the incision. The abdominal incision was closed in layers and the patient returned to bed in good condition. The uterus was opened and showed an area of placenta, about 5 centimeters firmly adherent to the posterior uterine wall from which it could not be separated. A clinical diagnosis of partial placenta accreta was made and the uterus was taken to Dr. Frank B. Mallory for further study.

Convalescence. The patient made an uneventful recovery, the drains were removed on the fifth day, the abdominal sutures on the ninth day, the incision had healed by first intention, and she was discharged well on October 7, on the sixteenth postoperative day. The discharge note was the following: "The incision in the arms and the abdominal incision are well healed, the cervix is healed, there are no masses or areas of tenderness in the pelvis."

Pathological report. Received from Dr. Frank B. Mallory—No. 30-2653 *Gross*—An opened post-partum uterus with tubes and ovaries attached. The ovaries are normal in appearance. The uterus measures about 15 centimeters across with a depth of about 15 centimeters. The uterus has been opened from above lying behind the cervix and attached to the mucosa of the posterior uterine wall is a blood stained spongy mass about 5 cm. in diameter.

Microscopic examination. No evidence of mucus can be found anywhere. Aside from this the chief lesion present is an extreme sclerosis of the blood vessels in the inner portion of the wall with obliteration of many of them due to organization of

thrombi. This condition seems of long duration and connected with previous pregnancies. A second condition is the deep penetration of villi into blood spaces and their attachment to the walls in places rendering removal of the placenta difficult. The decidua tissue in places lies between muscle fibers instead of being on their inner surface, that is on the inner surface of the myometrium, and is in large part hyaline owing to necrosis of the cells and disappearance of the nuclei. There is also necrosis of portions of the placenta and acute inflammatory infiltration.

Microscopic diagnosis. Placenta accreta with necrosis and acute inflammation.

The cause of this partial placenta accreta was probably the retained placenta with possible manual extraction at the second delivery.

CONCLUSIONS

1. The literature on placenta accreta has been reviewed and 82 cases of this pathological entity have been collected.

2. The average incidence was found to be 1 case in 14,622 deliveries. At the two extremes are found 1 in 6,000 to 1 in 40,000.

3. In the presence of a retained placenta without bleeding and without signs of separation the aseptic exploration of the uterus, under anesthesia, is called for in order to establish the diagnosis between simple adherent placenta and placenta accreta.

4. Manual removal is impossible with true placenta accreta.

5. Removal by morcellation results in rupture of the uterus, hemorrhage, sepsis, and usually death.

6 When the diagnosis of accreta is established the treatment should be hysterectomy and blood transfusion if the loss of blood has been severe.

7 Two personal cases of placenta accreta, one complete and one partial, are reported

I am indebted to Dr Frank B Mallory for the photographs illustrating this article.

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Fig. 10.



Fig. 1

Fig. 1. Technique of stripping periosteum. A wide periosteal elevator is used to free the outer surface of the rib to its upper and lower edges. The periosteal elevator is pushed *from the spine laterally* along the upper edge of the rib and in the opposite direction along the lower edge. A stripper completes the operation. Lower ribs.

Fig. 11. Division of the rib. Note the tips of the transverse processes of the vertebrae in relation to the divided rib. Lower ribs.

CLINICAL SURGERY

FROM THE DEPARTMENT OF SURGERY, UNIVERSITY OF CINCINNATI

A TECHNIQUE OF THORACOPLASTY¹

B NOLAND CARTER, M.D., CINCINNATI, OHIO

SINCE 1925 I have performed thoracoplasties on 90 patients with pulmonary tuberculosis.

During this time the technique of the operation has been greatly modified. Some aspects of our present operative procedure may be useful or at least of interest to other surgeons engaged in thoracic surgery.

In general, with increased experience has come a firm conviction of the value of following certain fundamental principles. These are painstaking hemostasis, gentleness in the handling of tissues, the resection of very long segments of ribs over the diseased area, and the use of many staged operations in cases in which the usual two stage one is felt to be hazardous.

Thoracoplasties are performed on patients whose general condition is as a rule, not good who have been ill for several years with a wasting systemic disease and whose power of resistance to any sort of additional strain is often problematical. Loss of blood in such patients is quite a different matter from that in a normal individual. During operations upon tuberculous patients, effort should be made to prevent the loss of every possible drop of blood. Every bleeding point is clamped as rapidly as possible. We do not feel that it is advisable to rely on pressure and hot packs for the control of bleeding. The average number of hemostats used in this clinic for one stage of a thoracoplasty involving five ribs is eight dozen. The rapidity of the operation is definitely determined by the assistants' ability in the matter of hemostasis. The time element is not considered especially important in the performance of thoracoplasties; the speed of operating is always subservient to our ideas of extreme gentleness and meticulous hemostasis. We do not believe that it is of much moment how long (within reasonable limits) one operates, provided the patient is not losing blood and is not being shocked by the rough handling of his tissues.

Particular attention is directed to several maneuvers which have been of great assistance in

preventing the undue loss of blood. The first of these is the method of dividing the muscles of the back. If these are cut in the ordinary fashion with a knife, the bleeding is troublesome to check since the vessels have a tendency to retract into the muscle. The auscultatory triangle is the space formed by the lower edge of the trapezius muscle, the upper edge of the latissimus dorsi muscle, and the border of the scapula (Fig. 3). When the fat and areolar tissue are divided in this space, the shining sheath enclosing the sacrospinalis muscle is exposed. Thus one can reach the cleavage plane between the chest wall and the overlying back muscles (i.e., trapezius, rhomboids and latissimus dorsi) without having to divide any vascular muscular tissue. With this cleavage plane exposed the finger or handle of a knife is introduced into the plane and the overlying muscles are stripped up from the chest wall. The operator can now grasp the muscles between thumb and fore finger of the left hand and directly opposite his grasp the assistant obtains a similar grip (Fig. 4). By reason of these pressures the segment of muscle is really placed between two tourniquets, and can be divided bloodlessly with scissors held in the



Fig. 1 The position of the patient on the table for an operation on the left side. The arm is allowed to hang over the edge of the table in order to facilitate the dislocation and retraction of the scapula.

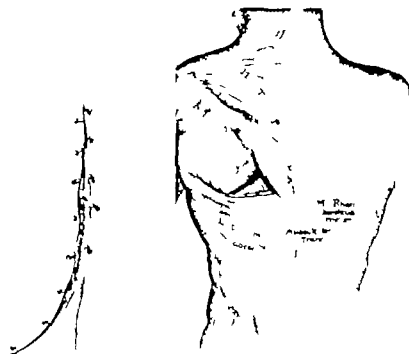


Fig. 2



Fig. 3

Fig. 2 The skin has been incised not quite down to the subcutaneous tissue and towels fastened to the skin edges with clips. If the incision is carried into the subcutaneous tissue some loss of blood occurs before the towels can be fastened. The line of incision is marked on the skin before iodination and draping are done. For clearness of detail, the towels are not shown in subsequent drawings.



Fig. 4

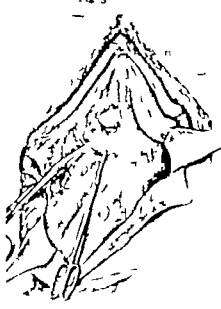


Fig. 5

Fig. 4 The anatomy of the auscultatory triangle has been exposed. Fig. 5 The tourniquetting procedure is used as the latissimus dorsal muscle is divided downward and outward. The operator's left hand is shown on the left. A knife is used to divide the muscles here in contrast to the scissors in Figure 4, as a knife is less awkward than scissors would be.



Fig. 6

Fig. 3 The anatomy of the auscultatory triangle.

Fig. 4 The auscultatory triangle has been exposed. Fingers have been introduced into the cleavage plane between the overlying back muscles and chest wall. The operator's left hand is shown on the left, and the assistant's hand on right. By compressing the muscles between thumb and finger as indicated, bleeding is controlled while the muscles are being cut with scissors held in the operator's right hand.

Fig. 5 The tourniquetting procedure is used as the latissimus dorsal muscle is divided downward and outward. The operator's left hand is shown on the left. A knife is used to divide the muscles here in contrast to the scissors in Figure 4, as a knife is less awkward than scissors would be.

Fig. 6 The overlying back muscles are being reflected from the ribs. By following the natural cleavage plane and by lifting the muscles upward and outward, the large vessels going from the chest wall to the muscles are seen and divided between hemostats without the loss of blood. Lower ribs.

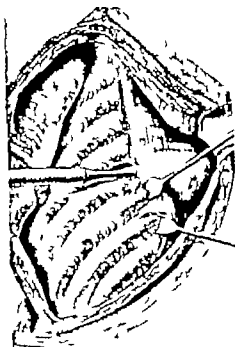


Fig 7

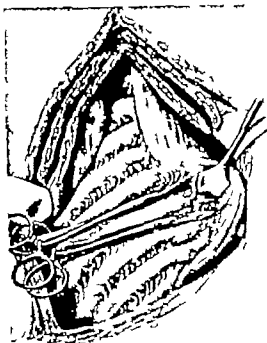


Fig 8



Fig 9.

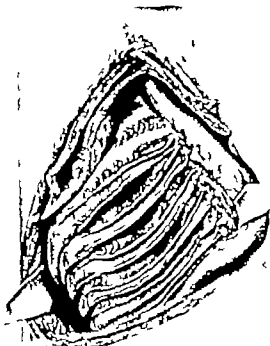


Fig 10

Fig. 7 The first step in mobilization of the sacrospinalis muscle. The narrow periosteal elevator follows the rib beneath the muscle all the way to the spine. Each rib to be removed is thus freed from the overlying muscle. Small retractors hold up the muscle throwing into view the muscular attachments in the intercostal spaces. Lower ribs.

Fig. 8. Second step in mobilization of the sacrospinalis muscle. The attachments of the muscle in the intercostal space are grasped with hemostats just below the lower edge

of the rib for it is here that a small artery enters the muscle. Lower ribs.

Fig. 9. Third step in mobilization of the sacrospinalis muscle. The tissues grasped in the hemostats have been divided and ligated. The muscle is now easily retracted medially until the transverse processes of the vertebrae are seen. The periosteum is now divided. Lower ribs.

Fig. 10 The operation on the lower ribs has been completed.



Fig. 5 The incision for the removal of the upper ribs. Note the auscultatory triangle in the lower portion of the incision.

operator's right hand. When the pressure is gently released the bleeding points can be readily located and grasped with hemostats before there is any retraction of the divided vessels. The open ends of many vessels can be seen and clamped without the loss of any blood. This procedure is repeated as one progresses upward, only as much muscle as can be grasped between the thumbs and fingers is divided at a time. The latissimus dorsi muscle is divided in the same way as the incision is carried downward or outward (Fig. 5). This same maneuver is repeated in subsequent operations. When the auscultatory triangle cannot be used a small incision is made through the trapezius and rhomboid muscles until the sheath of the sacrospinalis is seen, where the cleavage plane is easily found and the tourniquet procedure carried out.

Having divided the muscles of the back down to the plane of the sacrospinalis and ribs, the next step is to reflect these muscles and the scapula off the chest wall. This can be done easily provided one follows the natural cleavage plane already referred to. This plane is made evident by the retraction of the divided muscles off the chest wall as shown in Figure 6. By blunt dissection into the loose areolar tissue the muscles separate readily from the underlying structures. Several large vessels and nerves (running side by side) which traverse this plane as they proceed from the chest wall to the muscles, are encountered during the dissection. They can be isolated and divided between hemostats without the loss of any blood (Fig. 6).

Having reflected the muscles off the ribs, one is confronted with the picture as shown in Figure 7. The sacrospinalis muscle must now be drawn

medially thus exposing the ribs at their articulation with the transverse processes of the spine. The mobilization and retraction of the sacrospinalis can be accomplished almost bloodlessly. A narrow straight periosteal elevator is passed between the rib and muscle following the rib closely until the spine is reached. By raising the handle of the instrument the body of the muscle is partly raised from the rib. This maneuver is repeated at each of the ribs one has planned to remove, so that this muscle is free from the upper surface of the ribs but is not detached from the intercostal spaces. There is a vessel in each space which emerges from it and enters the sacrospinalis muscle. These vessels enter the muscle near the lower edge of the rib about midway between the edge of the muscle and the spine. When the muscle is lifted with small retractors placed where the muscle has been freed from the ribs, they are thrown into relief and may be grasped with hemostats before they are divided (Fig. 8).

Increased experience has convinced us that it is very necessary to resect great lengths of ribs beneath the scapula. Only by doing so can one get the requisite degree of collapse of the upper portions of the lung. It is here, of course, that the greatest degrees of collapse are needed. A recent procedure of exposing the upper ribs has made access to the ribs, and particularly to the first rib, very simple. This method was explained to me by Doctor John Alexander and has proved to be most useful. It consists in dividing the digitations of the serratus magnus muscle to the upper five or six ribs in the posterior axillary line. After they are divided the scapula can be thrown much farther off of the chest wall, which permits an easy access to the ribs far to the front of the chest. This exposure often makes it possible to see the costal cartilages of the upper four ribs, and always the axillary vessels and brachial plexus (Figs. 14 and 15).

In the stripping of the periosteum off the ribs, considerable bleeding will result unless one stays in the plane between the periosteum and the bone. If this plane is not followed, the intercostal vessels or pleura may be torn. After the periosteum is split to the desired length, a broad elevator is used to scrape it back until the upper and lower edges of the rib can be seen. On the lower rib edge the periosteum is freed with a smaller flat elevator operated *from without toward the spine* on the upper edge the course of dissection is *from the spine laterally*. Due to the manner in which the intercostal muscles are attached to the ribs, a reverse method of attempting to free

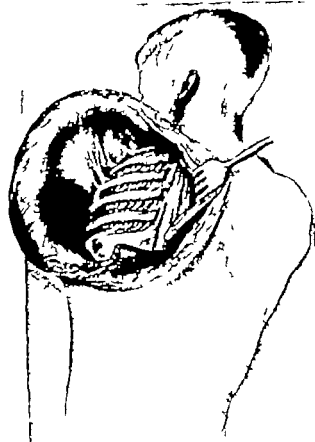


Fig. 14. Upper ribs. The scapula has been thrown laterally until the attachments of the serratus anterior muscle are seen. The serratus posterior superior muscle has been divided and its attachments are seen on second to fifth ribs.

the edges is much more difficult. After the edges have been freed a Doyen stripper is passed around the rib near the spine and with one stroke anterior the rib is easily bared.

With few exceptions all cases have been done under local anesthesia. Direct infiltration of the tissues is used until the ribs are exposed as shown in Figure 9. The intercostal spaces are then injected under direct vision. One per cent novocain is used in the skin and intercostal spaces, one-half per cent elsewhere. Thus far there have not been any severe reactions from the novocain. Recently the patients have received 3 grains of luminal at bed time the night before operation, 3 grains 2 hours before operation, and $\frac{1}{4}$ grain of morphine one-half hour before the patient is sent to the operating room. This preliminary preparation greatly allays nervousness and apprehension. Local anesthesia lessens the danger of aspiration into the good lung and also ensures a greater gentleness in the handling of tissues.

It has been our custom to divide the operation into two stages except in the case of those patients

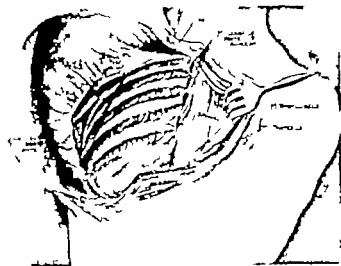


Fig. 15. Upper ribs. Exposure after the attachments of serratus anterior muscle have been divided. The scapula can now be dislocated much farther laterally. Note that the brachial plexus and the axillary vessels as seen from behind.

that are considered bad operative risks. Where there is any question as to the patient's ability to tolerate a two stage procedure the operation is done in three or more stages. Until recently the first stage has been a resection of the lower ribs except in patients who presented a small cavity at the apex and in whom a resection of ribs one to five or one to seven may suffice to cause healing. For some time this procedure was followed because a resection of the lower ribs was thought to be more formidable for the patient and it seemed more logical to subject him to the greater strain first when he was in the best condition. Lately we have reversed the procedure and feel that it is preferable to resect the upper ribs first because the scapula can be more widely raised off the chest wall if not held by the adhesions of the previous operations and thus one can resect longer lengths of rib beneath it. Also it seems more logical to attack the most diseased portion of the lung first so that if for any reason a second stage cannot be done, the most important portion of the lung will already have been collapsed. The second stage operation is normally performed 2 weeks after the first. In case of doubt as to the patient's ability to tolerate a second stage at the end of 2 weeks the operation is deferred until a later date. As a rule four or five ribs are resected at each stage.

The patients have been placed prone on the operating table with a small pillow or sand bag under the affected side so as to elevate that side of the chest and to allow the arm to be dropped over the side of the table when the scapula is to be raised from the chest wall. The incision is made

into but not through the skin, and towels are fastened to the wound edges with skin clips, as shown in Figure 2. With few exceptions silk has been used in making all sutures and ligatures. Drainage of the wound has not been employed in any case in our series.

SUMMARY

1. The author presents a description and illustrations of a technique of thoracoplasty

which has gradually been evolved in the personal performance of operations upon ninety patients.

2. Especial emphasis is directed to the method of exposure to meticulous hæmostasis, to extreme gentleness in the handling of tissues, and to the extensive rib resection. The length of time of the operation is considered to be of secondary importance.

3. Operations are performed under local anesthesia.

ASEPTIC URETERO-INTESTINAL ANASTOMOSIS

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Cleveland Clinic

THE clinical results secured by transplantation of the ureters into the rectosigmoid in recent years has established the procedure as a preferred method of treatment for certain pathological conditions. Its applicability in cases of exstrophy of the bladder is now recognized as a sound surgical procedure. More recently its field of usefulness has been extended to include certain cases of carcinoma of the bladder.

Various types of operations and refinements in surgical technique have been contributed by Mayo Coffey Lower Walters, and others. The most recent contribution has been Coffey's transfixion suture method. A modification of this principle is utilized in the procedure in experimental studies on dogs.

TECHNIQUE

A low median incision is made with the dog in a moderate Trendelenburg position. After the peritoneal cavity is opened the intestines are displaced from the pelvis and held away from the operative field by moist tapes.

The posterior parietal peritoneum is incised at the usual site and the ureter is freed from its bed by sharp dissection. The ureter is isolated for approximately 8 centimeters.

The point of transplantation into the rectosigmoid is then selected and an incision 6.5 centimeters long is made with a sharp scalpel along one of the longitudinal bands through the serosa and muscle layers to the mucous membrane of the bowel. Extreme care is exercised not to make an opening into the lumen of the bowel. Lateral separation of the serosa and muscle layers provides a trough which is to be occupied by the transplanted ureter (Fig. 1).

The bowel is replaced back in its normal position and the ureter to be transplanted is grasped at points in such position that kinking is prevented when the operation is completed. The ureter is then placed in the trough. One centimeter from the lower angle of the incision in the bowel, a silk suture is passed through the wall of the ureter which is in contact with the mucous membrane of the bowel. The suture is then carried through the intestinal mucous membrane (Fig. 1). This is a mattress suture and to avoid contamination always is put through the ureter before the bowel is entered. The size of the resulting uretero-intestinal fistula depends on the amount of tissue incorporated in the mattress suture.

The suture is tied quite tightly. Following this the muscle and serous layers are reapproximated over the ureter which lies in the trough (Fig. 2).

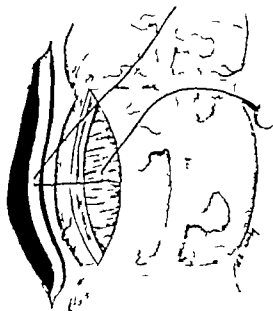


Fig. 1. Silk mattress suture carried through rectal wall and mucosa of bowel. Longitudinal incision through the serosa and muscular layers forming trough for transplanted ureter.

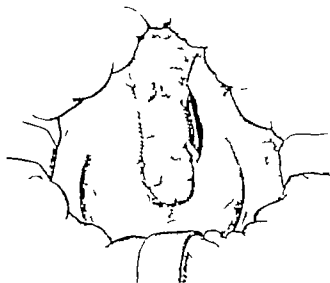


Fig. 2. Reapproximation of muscles and serous layers over the ureter. The continuity of the ureter is not interrupted. Suture of the posterior parietal peritoneum over the incision in the bowel.

into, but not through the skin, and towels are fastened to the wound edges with skin clips, as shown in Figure 2. With few exceptions silk has been used in making all sutures and ligatures. Drainage of the wound has not been employed in any case in our series.

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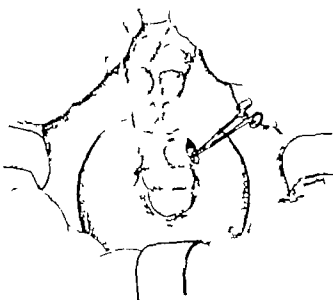


Fig. 5. Intrapertoneal division of the ureter after the new channel has formed between the ureter and bowel. This stump of the ureter is removed with the bladder when cystectomy is performed. This approach and removal of the stump of the ureter after it has been divided may also be removed by the retroperitoneal route in clinical cases.

cision in the bowel where they emerge from the trough. They are divided and ligated doubly with silk sutures thus severing the continuity of the ureter for the first time. At this point an additional suture may be used further to anchor the ureter to the bowel (Fig. 6). The small incision in the posterior parietal peritoneum is closed. After the small incision in the peritoneum is closed again, it is easy to remove the bladder and distal stumps of the ureter. In our clinical cases as the bladder is being mobilized for cystectomy, the ureters are isolated, divided and ligated with silk sutures at the point of emergence from the trough in the bowel. An additional anchoring suture of silk is placed at this point between the divided end of the ureter and bowel. Thus cystectomy and severance of the continuity of the ureters is accomplished without entering the peritoneal cavity.

RESULTS

This preliminary report deals with experimental investigations upon dogs. The immediate results are most satisfactory but insufficient time has elapsed to permit any definite conclusions as to the ultimate end results.

Anastomosis by this method performed upon cadavers would seem to indicate its practical applicability for clinical use.

The simplicity of the procedure and the lack of postoperative reaction has been most striking in

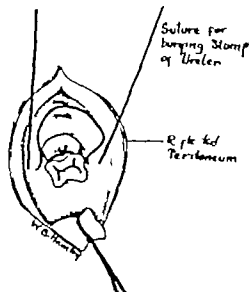


Fig. 6. Division of the ureter at the point at which it emerges from the trough in the bowel.

contrast to the other types of transplantation. Evidence of back pressure upon the kidney as indicated by hydronephrosis and also infection is absent months after operation due to the maintenance of the valve like mechanism of the bowel. The mortality from the transplantation is reduced to a minimum and complications are rare. Since the technique has been perfected none of the animals has had postoperative peritonitis.

CONCLUSIONS

A new technique is presented for simultaneous bilateral transplantation of the ureters into the rectosigmoid in which the normal course of the urine and the continuity of the ureter is not interrupted until after the formation of a new channel between the ureter and the bowel.

The operation is attended by no interruption of function in the kidney or the upper urinary tract until after communication between the ureter and bowel has been established.

Peritonitis and acute renal infection is reduced to a minimum.

The results in experimental animals have shown a lower mortality than that associated with other types of transplantation of the ureter into the bowel.

The immediate results are most satisfactory but insufficient time has elapsed to warrant any statement as to the distant end results.

NOTE.—Operations by this technique have been performed with most satisfactory results on 3 children with ectrophy of the bladder, 3 patients with carcinoma of the bladder and 1 with vesicovaginal fistula.

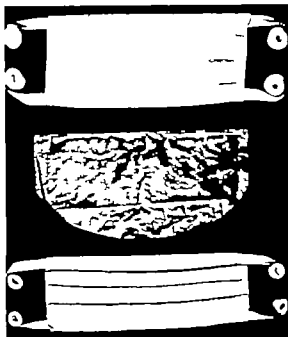


Fig. 2. A, Dimity ply pleats, B, Mellinger's wax paper copper wire, C, Capp-Weaver mask, 44 by 40 mesh, 3 ply 3 pleats.

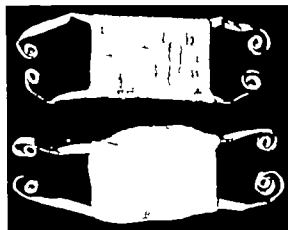


Fig. 3. Changes in mesh as a result of washing ordinary gauze mask (8 by 2 mesh, 6 ply)—above, washed below new.



Fig. 4. Our cellophane gauze mask in use.

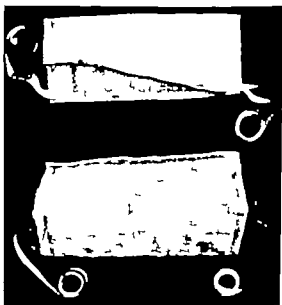


Fig. 5. Our cellophane gauze mask.

A BACTERIOLOGICAL STUDY OF THE EFFICIENCY OF FACE MASKS¹

MAURICE L. BLATT, M.D. AND MAURICE L. DALE, M.D. CHICAGO

INFECTIONS of the upper respiratory tract constitute a common cause of morbidity in both children and adults. No effective prophylaxis has yet been devised against them nor against some of the specific contagious diseases which enter through the same portal. If these two groups are considered together as they may well be from the standpoint of epidemiology and prophylaxis they assume numerically a dominant position in human illnesses. The prevention of these diseases and cross infection from them is a serious problem in the medical management of a children's or contagious hospital and in the private home as well. Their importance in the operating room has been the subject of a recent paper by Walker, who shows that infection of surgical wounds from organisms carried by expiratory droplets is an important factor in postoperative suppuration. An epidemic of severe infections in normally clean operative wounds frequently occurs in hospitals and necessitates a partial cessation of surgical work until the cause often a nasopharyngeal infection in an interne or nurse has been eliminated. These wound infections occur in spite of the common use of the gauze mask.

In the transmission of infection from the upper respiratory passages, the causative agent leaves the mouth or nose in droplets carried by the spray. The organisms are disseminated by talking, coughing or sneezing. Contaminated hands and eating utensils are factors to be considered in the control of an epidemic and the spread of disease from sporadic cases. Weaver (7) has shown that talking and coughing while the mouth is partially closed disseminates more organisms than the projectile cough with the mouth wide open while the air of quiet expiration has usually been found to be sterile.

It is obvious that one of the links in the chain needed to prevent the transmission of infectious material, is a germ proof facial mask. To be of practical value such mask must be inexpensive, comfortable and simple to adjust on the face. The apparatus must be so designed that droplets, however small will be intercepted. Various types of masks have been used in hospital wards and in operating rooms with varying degrees of success. Weaver (7) reported a reduction in the incidence of carriers among nurses and attendants

in his diphtheria wards from 23.5 per cent to 8.2 per cent, the only change in technique having been the use of his gauze mask. He succeeded in eliminating cross infection with scarlatina in the hospital the incidence of which had been 8 per cent before his mask was used. Cappe showed a 95 per cent reduction in scarlet fever and a 100 per cent reduction in cross infection from measles by the use of a mask of his own design, quite similar to that of Weaver.

Based on observations on attendants in 14 hospitals, Walker demonstrated a curve of incidence of operative wound infections coinciding with that of epidemics of upper respiratory disease. He concludes that none of the masks is effective unless an impervious material is placed across the line of discharge of the expiratory spray.

As in many other institutions in which infants are cared for gauze masks have been in use for the prevention of respiratory cross infection at the St. Vincent's Infant and Maternity Hospital. As part of an effort to control an outbreak of scarlet fever in January 1931 it was decided to test the efficacy of masks in common use. The details of the procedure were as follows:

A dust proof testing tunnel 2 feet high formed by a hood of cardboard over a table 3 feet by 7 (Fig. 1) was constructed. The tunnel was lined and covered with sterile sheets.

In performing the tests, two nurses with mild upper respiratory tract infections were each given one of the masks to be studied and instructed to wear it for 12 hours removing it only for

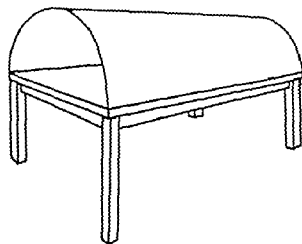


Fig. 1. Germ proof chamber

¹From the Department of Pediatrics, University of Illinois and St. Vincent's Infant and Maternity Hospital. Read before the Chicago Pediatric Society on March 13, 1932.

TABLE I.—PLAIN GAUZE MASK 6 LAYERS*
18 BY 22 GAUZE

| Distance in feet | No mask | New mask | hrs worn dry | hrs worn dry | New wet | 3 hrs worn wet |
|------------------|---------|----------|--------------|--------------|---------|----------------|
| 1' | 40.5 | 5 | 9.6 | 19.7 | 4 | 26.6 |
| | | 3 | 9 | | | |
| 3 | | 75 | | 75 | 7 | |
| 5 | 9 | 9 | 9 | 2 | 3 | 4 |

*The vertical columns in all the tables are the average number of colonies per plate at the indicated distance.

TABLE II.—STARCHED DIMITY MASK—LARGE

| Distance in feet | No mask | New mask | hrs worn mask | hrs worn mask |
|------------------|---------|----------|---------------|---------------|
| 1 | 33.5 | | 5.7 | 3 |
| | 6.3 | 9 | | |
| 3 | 3 | | | |
| 5 | | 6 | | |

meals. At the end of this period, each mask was wrapped in waxed paper and kept at room temperature for the next day's experiment. At 7:00 a.m. of the following day each nurse was given a fresh mask of the same variety to wear until 11:00 a.m. the hour for the cough plate procedure. The masks were tested in the following order: the 4 hour mask which she was wearing; the 12 hour mask worn the previous day; a fresh mask of the same sort; a fresh plain gauze mask; any other mask used in the comparison; and finally a test with no mask. The nurse was instructed to cough with pursed, partly closed lips exhaling completely with each cough, making the paroxysms as nearly uniform as possible. First a Petri dish of agar blood, or veal infusion, was held 2 inches from the mouth perpendicular to the direction of the cough current. The subject was instructed to cough six times toward this target. Three open agar plates were then placed on the floor of the sterile chamber respectively 1 foot, 3 feet, and 5 feet from the subject, who sat with her face at the mouth of the tunnel while she coughed six times over these plates. This was repeated with each mask tested and finally without a mask. For 4 minutes after each test, the plates were allowed to remain in the tunnel closed by sterile curtains at each end, while air suspended particles settled on them. A 3 minute interval was allowed between tests to assure clearing of the air in the test tunnel. After each series, an open agar Petri dish was exposed in the tunnel for 10 minutes as a check on air contamination of the chamber. The development

TABLE III.—PLAIN GAUZE MASK SOAKED
IN 20 PER CENT GLYCERINE

| Distance in feet | No mask | Fresh mask | 3 hrs worn mask | hrs worn mask |
|------------------|---------|------------|-----------------|---------------|
| 1' | 40 | 8 | 4 | 5 |
| | 5.4 | 4 | 4.8 | 4.8 |
| 3 | 6 | 8 | 4 | 8 |
| 5 | | | | 8 |

of more than two colonies on these between test plates was rare. If more appeared, the entire test just completed was discarded. From 4 to 12 tests were performed on each type of mask. The results are presented in the accompanying tables each table being an average of all the data obtained on a single type of mask.

The first tests were of the type of mask most commonly used in hospitals, six layers of gauze, 18 by 22 mesh, 4 by 5½ inches in size, with tapes at each corner (Fig. 3). As the figures in Table I show, enough tests proved its inefficiency when new as well as after 4 hours use. At the end of 12 hours, it was practically valueless. In view of the fact that a nurse's average working day is about 10 hours and but one mask is commonly used during this period, one may conclude from the number of colonies on cough plates that this procedure offers little protection to the patient. Weaver (7) has reported little difference between the dry and moist mask and our results (Table I) corroborate his findings.

The rapid deterioration of the gauze mask led us to believe that its efficiency might be increased by impregnating it with a bacteriostatic substance. Glycerine was chosen for the first trial. The plain gauze mask already described was soaked in 20 per cent glycerine and dried for 12 hours, then tested (Table III). It was far more efficient than the unimpregnated gauze mask, perhaps on a par with the dimity cloth mask tested later and deterioration during the day's use was not very marked. Similarly the effect of aluminum subacetate solution impregnation was investigated (Table V). This was apparently as efficient as the glycerine mask when fresh, distinctly superior to untreated gauze. There was but little deterioration during the first 3 hours use. With each of these preparations, the sticky moisture and the disagreeable odor made the masks uncomfortable with aluminum subacetate so uncomfortable as to make 12 hour tests impractical.

The next mask examined (Fig. 2A) was one made of a small checked dimity cloth 8½ by 7½ inches, with two pleats, each 1 inch wide,

TABLE IV.—H. V. MELLINGER'S MASK

| Distance in feet | No mask | New mask | 3 hrs. worn mask | hrs. worn mask |
|------------------|---------|----------|------------------|----------------|
| | 57.5 | 1.5 | 1.3 | 6.0 |
| | 3.7 | 0.75 | 5 | 2 |
| 5 | | 0 | 0.5 | 2.5 |
| 5 | 5 | 5 | 0.25 | 0.5 |
| Under chin | 5 | 75 | 2.75 | 3 |

TABLE V.—PLAIN GAUZE MASK SOAKED IN ALUMINUM ACETATE

| Distance in feet | No mask | Fresh dry mask | Fresh wet mask | 3 hrs. worn mask |
|------------------|---------|----------------|----------------|------------------|
| 3 | 3 | 3 | 5 | 3.5 |
| | 3.5 | 0 | 5 | 1.0 |
| 5 | 1.0 | 0 | 5 | 1.0 |
| 5 | 0.5 | 1.0 | 5 | 1.0 |

running transversely. This makes the finished mask $8\frac{1}{2}$ by $3\frac{1}{2}$ inches. There are tie tapes at each corner. This mask when fresh proved about 4 times as efficient (Table II) in the prevention of plate colonies as the previous common gauze mask. It lost about half of its efficiency after 4 to 12 hours use. It is better than the common gauze mask, fits the face well, and stands laundering. The texture of dimity is such that it is more comfortable than gauze.

A mask (Fig. 2B) designed by H. V. Mellinger was then investigated. It consists of a sheet of wax paper 9 inches across, $4\frac{1}{4}$ inches wide at the center and $2\frac{1}{4}$ inches at each end. It is held in place by a 16 inch copper wire that runs through a fold at the top, easily bent to conform to the bridge of the nose and to fit over the ears like spectacles. The bottom is open unattached, and consequently waves freely in rhythm with the respiration of the operator. It is a satisfactory mask when used for its designed purpose—nose and throat office work the wearer and patient sitting facing each other. When in use, the freely moving lower edge swings forward to a 30 degree angle with each exhalation so that the current of air is deflected downward and forward and the patient and operator do not breathe in each other's face. When leaning forward at the side of a crib at the patient's bed or at an operating table the air current is forced directly toward the patient and the purpose of the mask is defeated. Moisture particles condensed on the surface of the wax paper are blown off by coughing or violent exhalation and if allowed to accumulate, drip from the free edge. This mask

TABLE VI.—CAPP'S ARMY MASK

| Distance in feet | N mask | New mask | 3 hrs. worn mask | hrs. worn mask |
|------------------|--------|----------|------------------|----------------|
| 3 | 25.8 | 8 | 5 | 4.75 |
| | 7.0 | 3.4 | 1.4 | 5 |
| 3 | 3.6 | 1.0 | | 1.5 |
| 5 | 2.2 | 1 | 1.8 | 75 |

TABLE VII.—CAPP'S MASK SOAKED IN MERTHIOLATE

| Distance in feet | N mask | New mask | 4 hrs. worn mask | 12 hrs. worn mask |
|------------------|--------|----------|------------------|-------------------|
| 3' | 15 | 5.0 | 6 | 5.75 |
| 1 | 0.5 | 2.0 | 1.5 | 4.0 |
| 3 | 2.75 | | 6.0 | 4.75 |
| 5 | 4.0 | 3.0 | 6.5 | 6.75 |

becomes uncomfortable when worn for several hours as its top and sides are closed, holding a large space of dead, warm, very humid air in contact with the face and mouth. In the tests (Table IV) it is seen to be highly efficient, when new, for points directly in front of it. After a few hours, however, when moisture and organisms have accumulated on its surface, a large number of colonies appeared on the nearest plate. A plate placed close to the subject almost directly under a fresh mask also caught many organisms.

The mask (Fig. 2C) designed by J. A. Capps, consists of three layers of 44 by 40 mesh gauze 9 by 7 inches, with 3 transverse pleats of one half inch each, making it 8 by $2\frac{1}{4}$ inches when completed. Tapes at the corners hold it firmly to the face and under the chin. We agree with Capps' statement that although it looks very warm, it is quite comfortable. The plate results (Table VI) show it to rank in efficiency with the dimity cloth mask when new, and to be the more efficient of the two after having been worn a few hours.

Impregnating this mask with merthiolate (Table VII) showed no improvement over the fresh dry mask but it retained its original efficiency after 4 and 12 hours use. However the odor of merthiolate, though slight to smell, gradually becomes disagreeable when breathed for several hours. A more pleasant antiseptic, hexylresorcinol ST 37 solution was tried (Table VIII). The efficiency was the same when new as a fresh dry mask of the same type. After 4 hours, it deteriorated slightly but the plate count did not increase between that point and the 12 hour test. Capps' and Weaver's masks are so similar

TABLE I—PLAIN GAUZE MASK 6 LAYERS*
18 BY 22 GAUZE

| Distance in feet | No mask | New dry | 1st wet dry | 2nd wet dry | New wet | 1st wet wet |
|---------------------|------------|------------|-------------------|-------------------|------------|-------------------|
| | 49.5 | 5 | 9 | 10.7 | 14.4 | 26.6 |
| | | 4.5 | 9 | 4 | | 3 |
| 3 | 3 | 75 | | 75 | 7 | |
| 5 | 0 | 9 | 9 | 5 | 3 | 4 |

The vertical columns in all the tables are the average number of colonies per plate at the indicated distances.

TABLE II.—STARCHED DIMITY MASK—LARGE

| Distance in feet | No mask | New mask | 1st wet mask | 2nd wet mask |
|---------------------|------------|-------------|--------------------|--------------------|
| 1' | 55.3 | | 3.7 | 3 |
| | 6 | | | |
| 3 | 3 | 3 | | |
| 5 | | 6 | 4 | 3 |

meals. At the end of this period each mask was wrapped in waxed paper and kept at room temperature for the next day's experiment. At 7:00 a.m. of the following day each nurse was given a fresh mask of the same variety to wear until 11:00 a.m., the hour for the cough plate procedure. The masks were tested in the following order: the 4 hour mask which she was wearing, the 12 hour mask worn the previous day, a fresh mask of the same sort, a fresh plain gauze mask, any other mask used in the comparison, and finally a test with no mask. The nurse was instructed to cough with pursed partly closed lips, exhaling completely with each cough, making the paroxysms as nearly uniform as possible. First a Petri dish of agar blood or veal infusion was held 2 inches from the mouth, perpendicular to the direction of the cough current. The subject was instructed to cough six times toward this target. Three open agar plates were then placed on the floor of the sterile chamber respectively 1 foot, 3 feet and 5 feet from the subject who sat with her face at the mouth of the tunnel while she coughed six times over these plates. This was repeated with each mask tested and finally without a mask. For 4 minutes after each test, the plates were allowed to remain in the tunnel closed by sterile curtains at each end while air suspended particles settled on them. A 3 minute interval was allowed between tests to insure clearing of the air in the test tunnel. After each series, an open agar Petrie dish was exposed in the tunnel for 10 minutes as a check on air contamination of the chamber. The development

TABLE III—PLAIN GAUZE MASK SOAKED
IN 20 PER CENT GLYCERINE

| Distance in feet | No mask | Fresh mask | 3 hrs wet mask | 1st wet mask |
|---------------------|------------|---------------|----------------------|--------------------|
| | 10 | 2 | 4 | 1 |
| | 5.4 | 4 | 2.8 | 4.8 |
| 3 | 6 | 2 | 4 | 3 |
| 5 | | 4 | | 5 |

of more than two colonies on these between test plates was rare. If more appeared, the entire test just completed was discarded. From 4 to 13 tests were performed on each type of mask. The results are presented in the accompanying tables each table being an average of all the data obtained on a single type of mask.

The first tests were of the type of mask most commonly used in hospitals, six layers of gauze, 18 by 22 mesh, 4 by 5½ inches in size, with tapes at each corner (Fig. 3). As the figures in Table I show cough tests proved its inefficiency when new as well as after 4 hour's use. At the end of 12 hours, it was practically valueless. In view of the fact that a nurse's average working day is about 10 hours, and but one mask is commonly used during this period, one may conclude from the number of colonies on cough plates that this procedure offers little protection to the patient. Weaver (7) has reported little difference between the dry and moist mask and our results (Table I) corroborate his findings.

The rapid deterioration of the gauze mask led us to believe that its efficiency might be increased by impregnating it with a bacteriostatic substance. Glycerine was chosen for the first trial. The plain gauze mask already described was soaked in 20 per cent glycerine and dried for 12 hours, then tested (Table III). It was far more efficient than the unimpregnated gauze mask, perhaps on a par with the dimity cloth mask tested later and deterioration during the day's use was not very marked. Similarly the effect of aluminum subacetate solution impregnation was investigated (Table V). This was apparently as efficient as the glycerine mask when fresh, distinctly superior to untreated gauze. There was but little deterioration during the first 3 hours' use. With each of these preparations, the sticky moisture and the disagreeable odor made the masks uncomfortable with aluminum subacetate so uncomfortable as to make 12 hour tests impractical.

The next mask examined (Fig. 2A) was one made of a small checked dimity cloth, 8¼ by 7¾ inches, with two pleats, each 1 inch wide

leaves a half inch slack in the lower tapes. When completed, the mask is folded transversely across its center, making a strip 3 by $5\frac{1}{4}$ inches. When worn a single tie goes behind the head and the loop made by the two strips of tape sewed together is placed around or in front of the ears, dependent upon the conformation of the wearer's face. The upper and lower edges of the mask fit firmly against the face, while the center and sides are held away by the opening of the crease of the transverse fold aided by the loop of the two tapes at each side of the face. A free breathing space is thus established and the expired air is directed laterally and backward (Fig. 4).

Table IX shows the results of our tests on this mask. The number of organisms caught on plates directly in front of the nurse approached zero as closely as the limitation imposed by such experimental conditions permitted, and we found, as did Walker with his mask, that the air discharged at the sides was practically sterile. This was at first surprising but seems explainable as a physical phenomenon. The air is turned sharply laterally at an angle of over 90 degrees when it strikes the mask and is deflected. The particles of moisture and mucus being heavier than the air continue forward by virtue of their momentum. They strike the mask and due to their adhesive quality stick to, and are absorbed on the inner layer of gauze.

The nurses at St. Vincent's Infant and Maternity Hospital and at several other hospitals have worn this mask in the wards for hours. They state that it is more comfortable than the gauze masks worn previously. It is light, there is no valve action (since it is quite rigid and fixed in position) and due to the small residual air space is not intolerably hot. The current of air passing in and out causes a cool, not uncomfortable sensation in moderately hot weather. In our opinion a face mask can not be made pleasant for hot weather wear. This mask is however more tolerable in hot weather than gauze masks. Its greatest need in both homes and institutions is fortunately during the cold seasons, for upper respiratory infections are then more numerous. It is quickly and securely attached by a single tie. We have found that the mask will stand autoclaving several times, but it shows a tendency to crack or tear on washing. It is easily and cheaply manufactured from material in common use.

DEDUCTIONS

There is a noticeable disparity in the figures in columns 1 in the various tables. These figures were obtained under identical conditions but of

TABLE IX—OUR CELLOPHANE GAUZE MASK

| Distance in feet | No mask | New mask | 4 hrs worn mask | 12 hrs worn mask |
|------------------|---------|----------|-----------------|------------------|
| 2 | 23 3 | 0 | 67 | 0 13 |
| | 7 3 | 0 3 | 0 0 | |
| 3 | 3 | 0 8 | 5 | 1 3 |
| 5 | 1 7 | 5 | 67 | 0 67 |
| At sides | 0 | 0 3 | 0 | 8 |

necessity from groups of different individuals. We do not feel that a conclusion should be drawn from the fact that the number of organisms was reduced in percentage by the use of a mask. A percentage method of figuring seemed not applicable. The actual average count is therefore given without the mask and then with it. This seems to indicate the filtering quality of the mask. Our conclusion from the first column in each table is that there is a great difference in the number of organisms expressed by the cough of different individuals under like experimental conditions.

The present lack of agreement as to the causative agent or agents of common colds makes it impractical at this time to attempt immunization as a prophylactic measure against the upper respiratory tract infections. It seems desirable therefore that the use of a mask that deflects the mother's or attendant's breath away from the infant or patient is a logical procedure. That such an apparatus can be made entirely comfortable is improbable but that it can be made so comfortable that it will produce no hardships on the wearer has been accomplished with the cellophane gauze mask herein described.

To accomplish the reduction of infections emanating from the upper respiratory tract in the home, in the wards, in the infant asylum in the operating room and in contagious hospitals, the public must be made mask conscious and a method of supplying and prescribing an apparatus of the type herein devised must be instituted. It is simple in a hospital where masks are made by nurses or by patients supervised by nurses to produce a mask of this type. It is the opinion of an expert seamstress who has sewed regularly in one of the women's organizations of a large hospital that this mask is simpler to make than the common one of gauze which we believe to be inefficient.

SUMMARY

Based on the comparative data cited above we conclude that

1. The ordinary gauze mask is both uncomfortable and bacteriologically ineffective.

2 Our cellophane gauze deflection mask is inexpensive, easily put together quite comfortable, effective and practically germ proof as shown by our experiments and controls.

The authors express appreciation to Cecelia M. Kortom, R.N. for valuable bacteriological studies and mechanical assistance.

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CAROTID LIGATION FOR INTRACRANIAL ARTERIOVENOUS ANEURISM¹

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INTRACRANIAL arteriovenous aneurisms are of two types, developmental (Dandy, 2) and accidental (Locke, 10). The former have been given the name of angoma arteriale by Cushing and Bailey in their monograph on blood vessel tumors of the brain and are distinct from the pulsating exophthalmos which develops from accidental rupture of the internal carotid artery into the cavernous sinus. Carotid ligation is applicable to both and it is the purpose of this paper to present 4 clinical cases in which this treatment was used and to discuss the principles involved.

Arteriovenous aneurisms or fistulae occur at various places in the body and have similar features of etiology and symptomatology. The developmental or congenital fistulae have been assumed to arise from an aberrant persistence of the embryological arteriovenous capillary net work (Rienhoff, 16). These abnormal channels may lie latent for a number of years and then take on increased activity from some form of stimulus as puberty, pregnancy or physical strain. The traumatic arteriovenous aneurism is made possible by the common juxtaposition of large arteries and veins in the extremities or neck, where a perforating wound can establish direct communication between the two vessels.

The diagnostic symptoms of an arteriovenous aneurism are the vascular bruit which can be heard best over the communication, and the enlarged pulsating distal veins and proximal arteries. The bruit, which may be accompanied by a thrill, is due to the passage of a forceful current of arterial blood through a small opening from an area of high pressure to one of low pressure. It usually is transmitted proximally along the main artery even to the heart. A thrill is due to some irregularity or looseness in the border of the opening which makes vibration possible. The veins

which must carry this arterial pressure without an intervening capillary bed dilate and form large pulsating anastomosing masses of thin walled vessels and cause enlargement of the region involved.

The compensating dilatation of the proximal arterial trunks and even of the heart is a most interesting phenomenon of physiological response to a disturbed circulation. This has been convincingly demonstrated both experimentally and clinically by Holman to be dependent upon the amount of blood which finds its way through the fistula directly back into the heart. The enormous vascular dilatation which sometimes occurs, involving an entire extremity (Holman, 5) or all of the arteries of the neck and scalp (Cushing and Bailey) (Case 1 of this report) at first suggests some diffuse primary vascular pathology but the prompt symptomatic relief and subsidence of enlargement following closure of the arteriovenous fistula necessitates primary physiological interpretation.

Intracranial arteriovenous aneurisms possess a few distinctive features which merit special discussion. There is no juxtaposition of cerebral arteries and veins as elsewhere in the body except for the peculiar position of the internal carotid artery within the cavernous sinus (Fig. 1). This necessitates a limitation of the traumatic cases to the latter position and an embryonic developmental interpretation to those involving the brain. The absence of any reported case of cerebral arteriovenous aneurism found at birth indicates that the lesion is insignificant until some later activating influence causes its enlargement.

The developmental aneurism involves most frequently the middle cerebral artery although there are recorded cases involving other main arteries of the brain and a dilated posterior cerebral artery may contribute to an extensive middle cerebral

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aneurismal tumor (Case 2 of this report—Prof Dunn's case, Cushing and Bailey). The frequent middle cerebral involvement probably accounts for the high incidence of focal epilepsy or unilateral weakness which all observers have noted. Both patients of this report first consulted a physician on account of attacks of Jacksonian epilepsy with residual weakness in the arm.

Diagnosis of the developmental arteriovenous aneurism of the brain may be difficult or impossible if the tell tale intracranial bruit or carotid enlargement is not present. Careful auscultation over the head should be practiced in all suspected intracranial tumors, particularly when associated with epilepsy and no marked increase of intracranial pressure. X-ray films occasionally show faint curved shadows of calcium deposit suggestive of location in blood vessel walls, or a faint mottling at the site of an old hemorrhage (Case 2 Fig. 4).

If a suspicion of arteriovenous aneurism is entertained from suggestive vascular signs a test can be made to determine the oxygen content of the blood taken from the internal jugular vein on the suspected side (Horton, 7). The oxygen saturation of the blood in the internal jugular vein of normal subjects is 62 per cent, while that of arteries is approximately 95 per cent (Lennox). In Horton's (7) case the oxygen saturation of blood from the right internal jugular vein was 91.4 per cent and that from the left 93.8 per cent, which was considered diagnostic of an intracranial arteriovenous fistula. In my cases the results after carotid ligation were as shown in Table I indicating only one cure.

The traumatic intracranial arteriovenous aneurism involves constantly the internal carotid artery where it is surrounded by the cavernous sinus and lies close to the body of the sphenoid bone (Fig. 1). Rawling found that 70 per cent of basal skull fractures pass through the sphenoid sinus and thus commonly involve the firmly attached medial wall of the cavernous sinus and may also tear the enclosed internal carotid artery, leading either to fatal hemorrhage or an arteriovenous fistula. Arterial blood would then pass directly into the cavernous sinus with consequent dilatation of the least resistant tributaries of the sinus. The superior and the inferior petrosal tributaries posteriorly have thick resistant dural coverings as have also the cross connections to the other side and the sinus itself. The ophthalmic vein is the only tributary which possesses normal thin vein walls and is embedded in loose areolar tissue. Consequently it dilates from the arterial pressure it must carry and causes the pulsating exoph-

thalmos which is characteristic of the condition. The diagnosis is easy from the vascular bruit which can be heard subjectively and objectively usually from the time of the head injury and the increasing dilatation of conjunctival blood vessels, oedema, and exophthalmos. Rarely the condition can be confused with retro-orbital tumor or progressive exophthalmos of thyroid origin (Naffziger) in both of which a faint bruit may sometimes be heard.

The treatment of intracranial arteriovenous aneurism is limited to palliative measures for the carotid-cavernous sinus fistula is inaccessible to direct surgery and the pulsating network of dilated cerebral vessels in the developmental aneurism presents too great a risk of fatal hemorrhage for surgical excision (Cushing and Bailey Dandy 2). The common involvement of the internal carotid artery in the lesion and the proximal dilatation of this artery in many cases at once suggests carotid ligation. This has been applied with a fair degree of success but there are several factors which tend to defeat this measure. The normal hazard of carotid ligation from cerebral anemia or ascending thrombosis is placed at 20 to 25 per cent (Reid and Andrus 15) being slightly greater in internal than in common carotid ligation and varying considerably according to the age of the patient and the previous establishment of a compensatory anastomotic circulation.

The principles of proximal artery ligation in arteriovenous aneurisms elsewhere as established by Makins Holman (6) Reid, and others should be considered in carotid ligation. The presence of an arteriovenous fistula constitutes a powerful stimulus to the development of a collateral circulation even greater than artery occlusion. On this account ligation should be postponed at least a few months until this compensatory dilatation has had a chance to develop. Compression of the carotid artery would not be expected to increase this reaction except in the case with a small fistula and little or no evidence of arterial enlargement. Many of the cases of carotid-cavernous sinus fistula fall into this group and the disturbing ocular signs call for early interference. Compression of the common carotid artery here serves a double purpose. It enables one to detect inadequate anastomotic cerebral circulation on that side by the occasional production of syncope or paralysis from cerebral anemia. In such a case a prolonged course of compression, with increasing frequency and duration up to 1 hour several times daily without symptoms probably serves to increase the margin of safety in ligation. Also

compression treatment sometimes results in a cure or marked improvement, particularly in the early stages, and it is worth a trial. Various devices have been used for mechanical compression of the common carotid artery against the transverse process of the sixth cervical vertebra. Locke used a wooden collar with elastic band and pad across the front. Harkness, a simple application of two bicycle pump guards bound together while I have used a padded malleable iron collar with adjustable screw pad in a hinged front (Fig. 2).

The choice of ligation of the common or the internal carotid artery has not been established. The majority of ligations have been of the common carotid artery perhaps because of its easier accessibility. There is no very significant difference in the percentage of cure, benefit, or mortality and there are too many variable factors in a large series of cases to make figures very dependable. The mortality according to the series of Locke and later Harkness, is between 8 to 10 per cent, which is less than Reid's (15) figures of 20 per cent to 25 per cent for general common carotid ligation. This may be due to the compensatory anastomotic response in the arteriovenous cases which develops before operation. Probably little concern need be given in young individuals with evident arterial enlargement and no sign of cerebral anemia on compression.

The chief danger in carotid ligation is an ascending thrombosis which reaches and occludes the middle cerebral artery. Symptoms of this develop slowly within 12 to 24 hours, and rarely are changed by reopening of the artery (Reid). With this in mind it would seem more important to try to avoid this thrombosis than to be concerned about cerebral anemia. Ligation of the common carotid artery usually permits a continued circulation through the internal carotid, by the abundant anastomoses of the external carotid and reversed current through it into the internal carotid artery. This would tend to prevent thrombosis beyond the bifurcation but at the same time might defeat the primary purpose of the operation—closure of the arteriovenous fistula. In all 4 of my cases in which the common carotid was ligated with immediate improvement, there was a recurrence of disturbing symptoms and evident enlargement of the external carotid trunk within a few weeks. This necessitated later ligation of the internal carotid, with more lasting benefit. It may be open to question if internal carotid ligation then was any safer than it would have been in the beginning, or if a better result would have been obtained before too great com-

pensatory anastomosis had occurred. Each case will have to be judged by itself although it might be inferred that primary common and later internal carotid ligation would be the safer procedure, particularly in patients of arteriosclerotic age. Kerr, Dandy (3) and others advocate fractional ligation of the carotid arteries by means of a fascial band or removable aluminum band, as a further safeguard against cerebral anemia or thrombosis.

According to the observations of Holman (5) and Reid (14) on arteriovenous aneurism elsewhere in the body ligation of the proximal artery is not good therapy as it rarely succeeds and frequently leads to gangrene of an extremity although a possible exception is made in their statements about intracranial arteriovenous aneurisms. It is difficult to understand physiologically why this exception should be made although the clinical evidence of 90 per cent cure or benefit of the carotid-cavernous sinus cases certainly supports the exception. In trying to draw an analogy between the intracranial and systemic cases these writers have recommended simultaneous ligation of the internal jugular vein to favor the maintenance of adequate intravascular tension for cerebral circulatory function. Not enough cases have had this done to furnish a basis for clinical judgment of results although in a case reported by Reid (14) hemiplegia was not prevented by the maneuver. The rather free cross anastomoses of the large venous sinuses and arteries at the base of the brain may alter the physiological interpretation applicable elsewhere.

Carotid ligation for cure or improvement of developmental arteriovenous aneurism of the brain is less likely to succeed, due to the multiple fistulae usually present and the more marked compensatory arterial dilatation in these cases. The most favorable effect would be expected in the early lesion or in one which shows by X-ray a tendency to calcification and local thrombosis. Carotid ligation here might slow the circulation through the tumor mass sufficiently to favor further thrombosis, aided by deep X-ray therapy. This is the generally accepted method of treatment although rare cases may permit obliteration of the fistula (Dandy 2) electrocoagulation (Sachs, 17) and later complete excision (Cushing and Bailey).

SUMMARY

Intracranial arteriovenous aneurisms are of two types, developmental and accidental. The former involve the blood vessels of the brain while the latter are limited to carotid-cavernous sinus fistula.

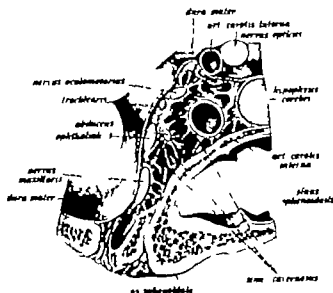


Fig 1 Cross section of cavernous sinus showing enclosed internal carotid artery and relation to sphenoid sinus. (Spalteholz.)

The diagnostic symptoms of arteriovenous aneurism are vascular bruit, distal pulsating enlargement of veins, and proximal arterial dilatation. This latter is a physiological compensatory phenomenon.

The high incidence of focal epilepsy in the developmental aneurism is explained on the basis of frequent involvement of middle cerebral artery.

Seventy per cent of basal skull fractures involve the body of the sphenoid bone and endanger the adjacent cavernous sinus and carotid artery.

The treatment of intracranial arteriovenous aneurism generally is limited to palliative measures as carotid ligation and X ray therapy. Rarely can the developmental aneurism be attacked directly without too great a hazard of fatal hemorrhage.

Carotid ligation for intracranial arteriovenous aneurism is at variance with the principles of treatment of similar aneurisms elsewhere in the body, but has had a high percentage of success in the traumatic carotid-cavernous sinus fistula.

Common carotid ligation leaves a greater margin of safety for anastomotic cerebral circulation than on account of this fact may be inadequate. Later ligation of the internal carotid artery probably is safer than as a primary procedure. Simultaneous ligation of the internal jugular vein has not been done a sufficient number of times to confirm its value as applicable elsewhere.

CASE REPORTS

CASE 1: Mr R. R., aged 26 years, Immanuel Hospital, No. 38217 admitted to hospital January 23, 1931 referred by Dr S. A. Swenson, Oakland, Nebraska. Diagnosis

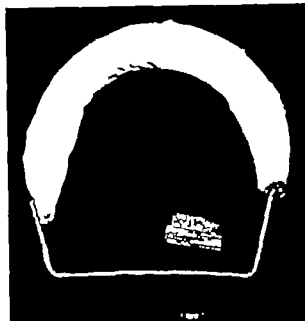


Fig 2 Padded malleable iron collar for prolonged compression of the common carotid artery.

Cerebral arteriovenous aneurism, left parietal with focal epilepsy and meningeal hemorrhage, treated by carotid ligation and X ray therapy. Improved.

This patient entered the hospital with the complaint of recurrent unconscious attacks followed by severe headache and bloody spinal fluid, lighter attacks with transient speech defect and peculiar sensation in his right hand, right sided blindness in both eyes, double vision and blurred vision in right eye. The right hemianopia was noted by his parents when he was a child and did not see things which were passed to him from this side at the table. He had no other symptoms until 1923, at the age of 18 years, when he was found unconscious in the barn. The spinal fluid was bloody and a diagnosis of pachymeningitis hemorrhagica interna was made. He was treated by spinal drainage and recovered within a week or two. Visual tests demonstrated a right homonymous hemianopia, vision right 20/15 left 20/20. His tonsils were removed in 1924. A chronic infection of the right maxillary antrum and a deviated nasal septum were found and a submucous resection done in 1925. In 1926 he began having headaches that were relieved by spinal puncture. He has had several attacks of unconsciousness with bloody spinal fluid with some pain located in his left temple, dilatation of his left pupil followed by some numbness in the right arm and leg and a word naming speech defect. He had numerous transient attacks of a peculiar sensation in his right arm with word naming difficulty without loss of consciousness. He had a severe unconscious attack in September 1930, with bloody spinal fluid, and following this he noted impaired vision in his right eye. Eye examination in November 1930, showed large opacities in the anterior vitreous and vision, right 1/200, left 20/30. In December 1930, vision in the left eye was reduced to 20/70, with increase in vitreous opacities. This was felt to be on a toxic basis and he had an operation on the ethmoid and sphenoid sinuses. He had another severe attack of unconsciousness on January 3, 1931 with clonic convulsions, bloody spinal fluid, and was gradually relieved by repeated spinal drainage. He was seen by Dr Keegan January 6, 1931 at his home during this attack. He was stuporous, had severe headache and

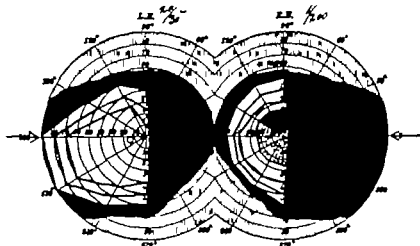


Fig. 3. Visual fields and vision of Case R.R. before carotid ligation November 3, 1930.

suboccipital pain, low grade fever, marked congestion of his conjunctival and retinal blood vessels, photophobia, and irritability. Spinal puncture released blood (tapped fluid under 30 millimeters of pressure). There was only increased pulsation over the left carotid arteries, called to attention by his parents. A left cerebral aneurysm was suspected but the patient's serious condition made moving him unsafe and he was continued under treatment at home by spinal drainage with gradual recovery.

He entered the Immanuel Hospital January 3, 1931, still rather weak but able to be up and about. His vision at this time was 20/200 in the right eye and 20/30+ in the left eye. The absolute scotoma in the right eye, recorded on November 3, 1930, had become relative and the same constant right homonymous hemianopia was present (Fig. 3). The right eye did not co-ordinate in movement with the left and turned in and down, although there was no definite paralysis. The left pupil was slightly larger than the right and responded sluggishly to light. The cranial nerves otherwise were normal. There was a small exos on the right upper lid. Carotid pulsation was visible on the left side, more beneath the angle of the jaw. An arterial bruit could be heard over the left internal carotid artery. A very faint bruit could be heard over the left parietal occipital region, stopped by compression of the left common carotid artery. The patient was not conscious of any noise in his head. There was no sensory motor reflex or co-ordination disturbance in the extremities. Astereognosis and spatial discrimination were normal. The right lower abdominal reflex was absent, cremaster reflexes present. The heart was not enlarged and the heart sounds were normal blood pressure, right 92/53, left 92/66. Electrocardiogram was normal. X-ray examination of the heart and great vessels showed normal size and contour.

X-ray films of the skull at first showed nothing thought to be significant, due to a right lateral exposure away from the lesion and poor film which did not bring out detail well. A recheck from the left side showed several very significant intracerebral shadows (Fig. 4) best interpreted by drawing (Fig. 5) on account of their faintness and poor reproduction from film. A well defined rounded area of calcification, by centimeters in diameter was found in the left medial parieto-occipital region, at first reported in the region of the pineal body but definitely situated about

1 centimeter to the left of the midline, by stereoscopic examination and anteroposterior view. This shadow was denser at its periphery suggesting calcification in the wall of an arterial aneurysm, apparently of the posterior occipital artery. The location of this lesion at the base of the calcareous fissure could well account for the right homonymous hemianopia. Another rather dense shadow appeared in the middle fossa just back of the dorsum sellae. This was about the width of a basilar cerebral artery and seemed to divide anteriorly and was suspected of being vascular calcification. A third group of faint shadows over an area of 3 to 4 centimeters in diameter, appeared in the region of the left angular gyrus at the end of the lateral cerebral or sylvian fissure. These were interpreted as calcification in an area of old hemorrhage, probably the source of the recurrent meningial hemorrhages and focal epilepsy he had suffered.

Ligation of the left common carotid artery was done January 27, 1931, under novocain anesthesia. Two silk ligatures were placed about the artery, with no subjective or objective evidence of cerebral anoxia. There was noted a compensatory dilatation of the right temporal artery lasting several days. The ligation had no appreciable effect upon the hemianopia. A vascular bruit could still be heard over the left external carotid artery indicating considerable anastomotic return circulation which probably would necessitate later ligation of the internal carotid artery. He was given deep X-ray therapy over the left parieto-occipital region on February 2, 1931. The visual fields on this date were unchanged.

He had a recurrence of his petit mal focal epileptic attacks on February 23 and March 1, 1931. When seen March 3 there was slight increase in the bruit over the left external and internal carotid arteries. This central scotoma in his right eye had disappeared and his vision was, right 20/30+1, left 20/30+1. His fields showed a sharp cut right hemianopia (Fig. 6). He complained of increased diplopia due to persisting loss of muscle balance in the right eye. He was continued on light doses of lamineal and had no more epileptic attacks. A second X-ray treatment was given March 24, 1931. His general health improved and he suffered no left sided headaches as before the ligation.

December 6, 1931, he developed a severe headache followed by a convulsion and unconsciousness. Spinal punc-

ture revealed a bloody fluid under marked pressure. He gradually improved under repeated spinal drainage at his home and re-entered the hospital January 18, 1932. There was rather prominent pulsation and bruit over the left external and internal carotid arteries, indicating increased caliber and probably return of high arterial pressure in the lateral cerebral artery. No bruit could be heard over the skull. There was some question whether the recurrent hemorrhage did not come from a medially situated posterior cerebral aneurism but ligation of the left internal carotid artery seemed indicated in view of the evident increased circulation through this side.

Operation. January 20, 1932 the left internal carotid artery was ligated under novocain anesthesia. No disturbance of cerebral circulation resulted and the patient made a rapid and uncomplicated recovery. He was given a third X-ray treatment January 25 and was dismissed January 30, 1932.

He has had no recurrent hemorrhage since this last ligation, has gained in strength and is able to do light work. He still has occasional petit mal attacks which are so slight as not to be detected by those with him. When last seen October 1, 1932, there was rather prominent pulsation and bruit over his right carotid vessels and in lesser degree on the left side. No intracranial bruit was heard. Oxygen saturation determination of blood from the left internal jugular vein showed 64.6 per cent in comparison to 76.3 per cent in the arm vein blood. These figures would indicate persisting extensive arteriovenous communication.

This case presents a typical history of left middle cerebral arteriovenous aneurism with early right homonymous hemianopia, focal epilepsy and meningeal hemorrhages developing over several years without a correct diagnosis. Even the X-ray shadows of calcification were overlooked in the first head films although the carotid enlargement and intracranial bruit had then been noted. These shadows indicated both middle and posterior cerebral artery involvement, which made the value of carotid ligation questionable. However there was definite improvement in vision and lessening of epileptic attacks. One recurrent meningeal hemorrhage following common carotid ligation indicates the necessity of final internal carotid ligation. The period of 9 months good health since this last ligation is too short to predict an entirely favorable outcome, particularly in view of the high percentage of oxygen saturation found in the internal jugular blood which indicates an extensive persisting lesion.

Case 2. Mr. C. C. aged 20 years, Clarkson Memorial Hospital No. 39,638, admitted October 28, 1926. Wise Memorial Hospital, No. 24,776, admitted May 1, 1927. Referred by Dr. C. A. Roeder. Diagnosis: Cerebral arteriovenous aneurism, right parieto-occipital developmental in origin, focal epilepsy treated by bilateral common carotid ligation, craniotomy. Improved.

This patient entered with the complaint of night occipital pain and convulsions involving his left arm. He stated that he was perfectly well until 1918 when at the age of 12 years he had influenza with pneumonia and was in bed about 3 weeks. He recovered strength slowly and began to have night occipital headache and pain in his right ear

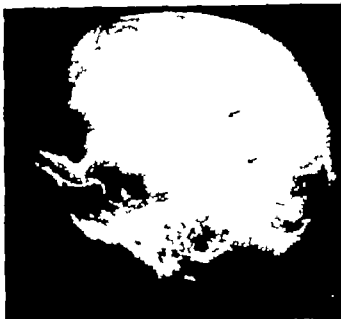


Fig. 4. Roentgenogram of Case 1, R. R., showing intracerebral shadows suggestive of vascular calcification.

every morning, which have gradually increased in severity. He has had some impairment of vision for about 10 years for which he has worn glasses. This became more noticeable after the influenza and about 4 years ago he began to have occasional pain and watering in his right eye. Recently he has had occasional double and blurred vision. During the past 5 years he has had attacks of numbness and tingling sensations in his left arm and hand, slightly in the left leg and foot, with disturbance in sense of position of his leg when walking. During the past year he has had weakness in his left arm. Four years ago while talking to a friend he first noticed twitching of the left arm and leg, followed by clonic, then tonic spasms of the left arm and leg, with loss of consciousness for several hours. These attacks have been repeated at intervals of 3 to 6 months since that time and apparently are decreasing in severity. He has noticed an enlargement of his neck for the last 8 or 10 years and has had difficulty in swallowing at times. During the past year he has had attacks of nausea and vomiting, relieved by appendectomy in March, 1926. His tonsils were removed 10 years ago and a nasal septum operation done 1 year ago for eye symptoms. He has a hacking cough and some dyspnea on exertion. He has had dizziness and vertigo with a tendency to fall to the left. The right ear rings occasionally when lying on the right side, sounds like a freight train. He is not aware of any other noise in his head. He has had urinary difficulty during the past 4 years. His father and mother one brother, and five sisters are living and well. His mother has had roaring in her head for 4 years associated with impaired hearing and no vascular signs. The history otherwise was not significant.

Examination revealed a young man of medium stature and development, weight 130 pounds. There is quite evident fullness of the neck on each side with visible pulsation over both carotid arteries. Behind both mastoids the occipital arteries are greatly dilated to form compressible pulsating areas, larger on the right side. A loud vascular bruit with thrills could be heard over these enlarged vessels. The visual fields showed a complete left homonymous hemianopia with constriction of the remaining right fields. (Fig. 7) Vision was 10/20 in the right eye and 10/70 in

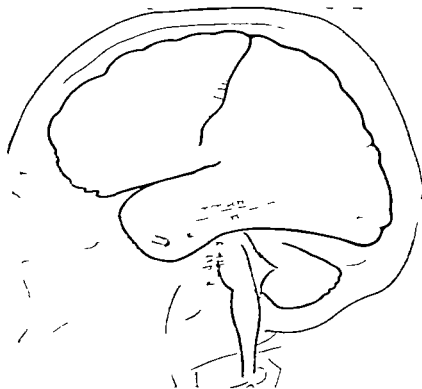


FIG. 1. Reconstructed drawing of reconstruction of Case 1, P. 1, showing position of shadows of intracranial shadows to cerebral arteries.

the left. There was slight anisotropia to the right, marked to the left. The corneal reflexes were light in color, corneal normal or elevating. Pupillary movements were normal, the lids closed. There was a slight left hemiparesis, involving the arm, face, and leg, more in greater degree than the right arm. Tendon reflexes were slightly increased on the left side with a normal left ankle clonus and Babinski's reflex. A disturbance in sensation was detected. Coordination was normal. The thyroid gland appeared enlarged, pink, and vascular dilatation. The heart rate was 100, second sound normal, the first sound obliterated by a weak second sound. The second sound was accentuated. The heart was somewhat normal to pericardial, slight enlargement of heart and aorta was reported by X-ray. Electrocardiogram was normal, basal normal, second sound 3. The tone, base, and Wassermann tests were normal. X-ray report of the head was as follows: All bones of the head and neck present were degree of abnormality. The cervical vertebrae are very irregular in contour. The scapulae are flat and wedge-shaped, having no posterior wall. The diameter of all the diploic spaces of the skull are very much widened and accentuated. The skull appears normal, suggesting intracranial pressure. About 3 centimeters posterior to the right mastoid, a thin area in the occipital bone which is funnel-shaped and about 3 centimeters across the widest portion which is internal with small foramina through the external plate.

In view of the evident rather diffuse bilateral carotid dilatation, with probable right occipital temporal intracranial thrombosis, ligation of the carotid arteries seemed warranted and necessary before any intracranial exploration could be considered. Accordingly Dr. C. A. Powder

ligated the right common carotid artery November 9, 1921, and the left common carotid artery December 6, 1921, under novocain anesthesia. Following the right ligation the patient complained of numbness in his left arm and hand, similar to the sensation which accompanied the occlusions in the arm. This improved in a few days. After the left common carotid ligation his left hemiparesis was greatly increased but rapidly improved. The carotid and occipital pulsation and bruit were gone and his occipital pain relieved. His voice was husky due to left laryngeal paralysis. He had no convulsions and was discharged December 20, 1921, up and about, greatly improved.

He entered the Wise Memorial Hospital May 1, 1922, for further study of his intracranial condition. The strength in his left arm had improved to the best it had been within a year. Slight huskiness of voice and a dry cough persisted, with a tendency to choke when drinking. The right occipital and ear pain had recurred although not as frequent or severe as before the ligation. Attacks of weakness in his left arm had recurred. He also described numerous attacks of a "rotten taste" which come on suddenly and last a few minutes, present during the past 3 years. Physical and neurological examination was essentially the same except for the decreased carotid and occipital vascularity. It was decided to explore the right temporal lobe, probably indirectly, and his right temporal bone flap was turned down May 11, 1922. Translucence of the bone was encountered in the triglochin area of the mastoid, and a large sinus running parallel to the broken border was torn. This was controlled by silk ligature about the middle of each side of the opening. The dura was not tense but felt quite soft as though a

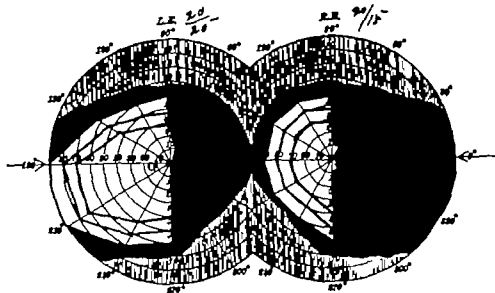


Fig. 6. Visual fields and visions of Case 1 R. R. after carotid ligation. June 16, 1931

blood lake were beneath. Due to the considerable hemorrhage and beginning drop in blood pressure at this stage the bone flap was replaced and a second stage exploration was done May 17 1931. The dura along the medial and posterior borders was opened with no serious bleeding but anteriorly a large thin walled vessel almost 1 centimeter in diameter appeared with numerous lesser dilated vessels which bled when the dura was elevated. No tumor other than the dilated vessels could be identified and nothing further was done on account of the danger of starting uncontrollable hemorrhage. The dura was closed and the bone flap replaced. A decompression was not done on account of the extreme vascularity in the right temporal region and the absence of intracranial pressure.

The patient recovered satisfactorily. He developed an acute nasopharyngitis after the first operation which delayed the second exploration. Also he had a light convulsion on May 13. He reported some relief from pain in his head and improvement in numbness in his left hand which had appeared after the second operation. He was discharged May 30.

He had no more convulsions until December when he had a light attack in his left arm. He was feeling well and working in a grocery store. He had another mild focal attack March 25, 1932 during sleep and these have recurred at intervals of a few months since. He was examined September 7 1932 and presented considerable recurrent enlargement and visible pulsation of his cervical and

occipital arteries. A loud vascular bruit could be heard over these vessels, variable in quality in places near the skull a continuous machinery-like roar. A thrill was felt over the left common carotid artery. Only a very faint systolic bruit could be heard over the skull, best in the right temple. The patient was not conscious of any noise in his head except occasionally when he would lie on his right side. He had had a generalized convulsion the night before, following the taking of three strong cathartic pills which contained 1/30 grain of strychnine. He was advised to discontinue this medication and limit his cathartic to cascara, mineral oil, and salines. He had been having occasional petit mal attacks but was able to do light work under home supervision. At this visit oxygen content and oxygen capacity tests were made on blood drawn from the right internal jugular, the right external jugular and an arm vein. A 93 per cent oxygen saturation was found in the internal jugular blood, 83 per cent in the external jugular blood, and 61 per cent in the arm vein blood (Table I) indicating a high percentage of arterial admixture in the jugular blood from an arteriovenous fistula.

This case presents the typical picture of an extensive developmental arteriovenous aneurism of the right cerebral hemisphere. The left homonymous hemianopia, left sided focal epilepsy and hemiparesis, marked dilatation of the cer

TABLE I.—OXYGEN DETERMINATIONS OF INTERNAL JUGULAR AND ARM VEIN BLOOD IN CASES OF INTRACRANIAL ARTERIOVENOUS ANEURISM AFTER CAROTID LIGATION

| Cases | Internal jugular blood | | | Arm vein blood | | |
|-------------|------------------------|-----------------|-------------------|----------------|-----------------|-------------------|
| | Oxygen content | Oxygen capacity | Oxygen saturation | Oxygen content | Oxygen capacity | Oxygen saturation |
| R. R. | 1.30 | L. | 1.016% | 10. | .3 | 76% |
| C. C. | R. 1.3 | R. 10.4 | R. 91% | 9 | 10.4 | 61% |
| J. J. P. G. | L. 13.8 | L. 16.8 | L. 81% | 13.3 | 16.8 | 70% |
| 4. T. L. | R. 13 L. 7 | R. 20 L. 20 | R. 68% L. 86% | 7.13 | 20. | 36% |

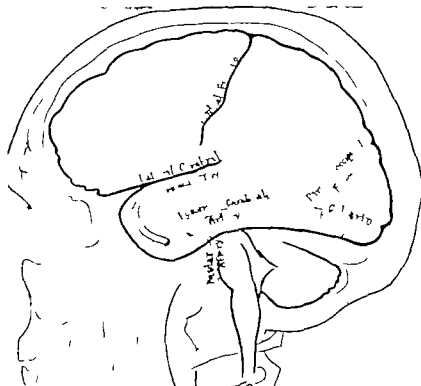


Fig. 5 Reconstructed drawing of roentgenogram of Case R. R. showing probable relation of intracerebral shadows to cerebral arteries

the left. There was slight nystagmus to the right, marked to the left. The optic discs were light in color, vessels normal, no elevation. Ocular movements were normal, the lids congested. There was slight left hemiparesis, involving the face, palate and tongue in greater degree than the arm and leg. Tendon reflexes were slightly increased on the left side with positive left ankle clonus and Babinski. No disturbance in sensation was detected. Co-ordination tests were negative. The thyroid gland appeared enlarged, possibly due to vascular dilatation. The heart rate was 80, blood pressure 120/70, the first sound obliterated by a blowing systolic murmur. The second sound was accentuated. The heart size appeared normal to percussion, slight enlargement of heart and aorta was reported by X-ray. Electrocardiogram was normal, basal metabolism minus 3. The urine, blood, and Wassermann tests were negative. X-ray report of the head was as follows: All bones of the head and neck present some degree of abnormality. The cervical vertebrae are erythroclastic in contour. The sella turcica is flat and saucer shaped, having no posterior wall. The channels of all the diploic veins of the skull are very much widened and accentuated. The skull appears mottled, suggesting intracranial pressure. About 2.5 centimeters posterior to the right mastoid is a thin area in the occipital bone which is funnel shaped and about 3 centimeters across the widest portion which is internal, with small foramen through the external plate.

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ligated the right common carotid artery November 18, 1926, and the left common carotid artery December 4, 1926, under novocain anesthesia. Following the right ligation the patient complained of numbness in his left arm and hand, similar to the sensation which accompanied the convulsions in the arm. This improved in a few days. After the left common carotid ligation his left hemiparesis was greatly increased but rapidly improved. The carotid and occipital pulsation and bruit were gone and his occipital pain relieved. His voice was hoarse due to left laryngeal paralysis. He had no convulsions and was discharged December 30, 1926, up and about, greatly improved.

He entered the Wise Memorial Hospital May 1, 1927 for further study of his intracranial condition. The strength in his left arm had improved to the best it had been within a year. Slight hoarseness of voice and dry cough persisted, with a tendency to choke when drinking. The right occipital and ear pain had recurred although not as frequent or severe as before the ligations. Attacks of weakness in his left arm had recurred. He also described numerous attacks of a "rotten taste" which come on suddenly and last a few minutes, present during the past 3 years. Physical and neurological examination was essentially the same except for the decreased cervical and occipital vascularity. It was decided to explore the right temporal lobe, probably bilaterally and a low right temporo-parietal bone flap was turned down May 5, 1927. Troublesome diploic bleeding was encountered in the trephine above the mastoid, and a large stone running parallel to the broken border was torn. This was controlled by a silk ligature about the vessel on each side of the opening. The dura was not tense but felt quite soft as though



Fig. 9. Photograph of Case 4, T. L., showing marked dilatation of conjunctival blood vessels of left eye and paresis of left external rectus oculi muscle before carotid ligation.



Fig. 10. Photograph of fundus of left eye of Case 4, T. L. showing dilated retinal veins.

Ophthalmoscopic examination showed marked engorgement and tortuosity of the left retinal veins, physiological cupping of both discs, slight evidence of arteriosclerosis. The right external rectus oculi muscle was paralyzed, ocular movements otherwise were normal. Visual fields and vision were normal. A vascular bruit could be heard over both internal carotid arteries, over both temples, and the forehead slightly louder in the left temple than the right. Digital compression of the left common carotid artery reduced the bruit both subjectively and objectively to a very faint murmur while compression of the right common carotid artery had little effect. Sustained compression of the left common carotid artery caused no syncope or paralytic symptoms. There was a healed scar in the lower neck from thyroidectomy a year before, no evidence of recurrence. The pulse ranged from 70 to 80 per minute, blood pressure 124 systolic, 80 diastolic, no tremor. The heart sounds were normal, no arrhythmia, the apex beat was 2.5 centimeter beyond the midclavicular line. Physical examination otherwise was negative. The urine was normal, red blood cells 3,660,000, hemoglobin 80 per cent, white blood cells 5,000, polymorphonuclears 73 per cent, mononuclears 27 per cent. X rays of the skull showed a linear irregularity in the left parietal bone suggestive of fracture no demonstrable pathology in the petrous ridges or at the base. A chest film showed a wide aorta with considerable calcification.

Although preliminary tests gave no evidence of cerebral vascular deficiency from left common carotid compression of 10 minutes duration the patient was subjected to a month's course of increasing intermittent carotid compression to 30 minutes four times a day delayed by a mild acute bronchitis and nervous reaction. A collar with adjustable screw pad (Fig. 3) was made to facilitate prolonged compression. Repeated studies were made of variations in blood pressure in the two arms during compression with rather variable results. There was a tendency to a systolic rise of 10 or 15 millimeters during compression, about 5 millimeters greater on the left side, with a drop of 5 to 10 millimeters on both sides after compression. The resting systolic blood pressure varied considerably from 160 to 100, apparently dependent upon the patient's mental reaction. The vascular bruit likewise varied in intensity with the blood pressure and for a time with a rather consistent low blood pressure around 110 it was hoped that progress was being made in reducing the arteriovenous fistula. During compression the right external rectus oculi muscle paralysis was definitely improved, subjectively and objectively and the conjunctival congestion seemed slightly less. With

later rise in blood pressure it was evident that no progress was being made and ligation of the left common carotid artery was advised.

Operation was performed February 2, 1932 under novocain anesthesia. The left common carotid artery was exposed, compressed by a single tie silk ligature for 1 hour, with no symptoms of cerebral anemia, before the final ligature was applied and the wound closed. Care was taken not to traumatize the inner coats of the artery by too tight a tie, which might favor ascending thrombosis. The patient made an uneventful postoperative recovery with no sensory, motor or reflex disturbance on the right side. The systolic blood pressure rose from 110 before the operation to 135 after and there was a visible compensatory dilatation of the right temporal and left supra-orbital arteries which lasted several days, gradually subsiding. The loud vascular bruit was relieved but a faint subjective and objective bruit remained.

The vascular injection and conjunctival edema of the left eye noticeably improved and more lateral movement of the right eye was possible. The patient was conscious of a modified faint bruit as of blood passing across the frontal region from the right side. When sitting in a chair the bruit sometimes disappeared entirely. She was dismissed February 26, 1932 still rather depressed over the faint bruit which she heard worse at night, sometimes awakening her by a louder throbbing character. When seen again April 6, 1932 the noise in her head still distressed her although much less than before the operation and there was an increasing congestion and edema of the



Fig. 11. Photograph of Case 4, T. L. after carotid ligation showing marked improvement.

left eye. Pulsation could be seen and a bruit heard over the left external carotid artery below the angle of the jaw. Compression here markedly reduced the head noise. Compression of the left common carotid artery had no effect indicating a marked compensatory enlargement of the external carotid artery with reversed blood flow into the internal carotid artery. Ligation of the left internal artery was advised and she was admitted to the hospital April 9, 1932.

Operation. The left internal carotid artery was ligated April 11, 1932 under novocain anesthesia. The artery was about half normal size and carried a definite pulsation which was rather easily compressed. A preliminary silk ligature was placed about the artery and maintained under observation about 30 minutes. The subjective noise disappeared and there were no symptoms to indicate cerebral circulatory deficiency. A double ligature was applied and the wound closed.

There was a barely perceptible bruit heard by patient during the night following the operation. The next morning the noise was louder but not as disturbing as before the operation and of a different quality. It was more like a throbbing or pulsating sensation and not so harsh as before. Auscultation detected the bruit over the entire right carotid artery and as loud in the right temple as in the left, which was interpreted as largely due to compensatory right-sided arterial dilatation. The right temporal and left supra-orbital arteries again were visibly dilated for a few days. On April 5 variable whistling noises were heard subjectively and objectively over the left temple, suggestive of partial obstruction of the arteriovenous communication. No subjective or objective noise could be heard on April 8, and there was marked improvement in the vascular injection and edema of the left eye. The left pupil was moderately dilated, indicating cervical sympathetic trunk disturbance. On April 23 the blood vessels of the left eye appeared almost normal, there was no prominence of the eye and very little paresis of the right external rectus oculi muscle. Double vision was noted only on looking to the extreme right. The blood pressure was 90/60 in the right arm and 75/55 in the left. Ophthalmoscopic examination showed some remaining enlargement of the retinal vessels but much less than before the operation. The patient was discharged April 26 and has been seen several times since. She remains entirely relieved of her noise, the eyes are normal, and she has resumed normal activity. On September 7, 1932, blood was drawn from the left internal jugular vein and from an arm vein for tests of oxygen content and capacity. The oxygen saturation in the jugular blood was 82 per cent and in the arm blood 79 per cent, showing little difference and indicating probably complete closure of the fistula.

This case presents a typical history of traumatic carotid-cavernous sinus fistula with immediate intracranial bruit and gradually increasing pulsating exophthalmos from ophthalmic vein enlargement. Paralysis of the right sixth cranial nerve on the opposite side from the lesion, was difficult to explain, except by assumption of some unusual anatomical condition which permitted local anastomotic venous dilatation and sixth nerve pressure on the right side. This might come through a tributary of the petrosal sinuses in the posterior fossa. The preceding exophthalmic gitter was confusing in interpretation of exophthalmos caused by the arteriovenous aneurism.

Ligation of the left common carotid artery was inadequate to relieve the patient of distressing symptoms, although much improved. Later ligation of the internal carotid led to a complete cure. The phenomena of temporary dilatation of the temporal and supra-orbital arteries, persistence of a modified more pulsating bruit for a couple of days, terminated by whistling noises enabled one to visualize in imagination the manner of vascular reaction and closure of the fistula. The oxygen saturation test of the internal jugular blood conformed to the clinical cure of the patient.

CASE 4. Mr. T. L. aged 24 years, University of Nebraska Hospital, No. 38, 74, admitted March 8, 1932, referred by Dr. C. K. Strubbe, Fremont, Nebraska. Diagnosis: Intracranial arteriovenous aneurism, traumatic in origin, involving the left internal carotid artery and cavernous sinus, treated by carotid compression, ligation of left common carotid artery later ligation of left internal carotid artery. Improved.

This patient entered the hospital with the complaint of a throbbing noise in the left side of the head, prominence and congestion of his left eye, double vision. He received a blow over the left temple in October, 1931 and was unconscious about 12 hours. When he regained consciousness, he noted headache, a paralysis of his right arm and leg, speech difficulty and an intermittent blowing noise in his left ear. The paralysis gradually disappeared in 3 or 4 weeks, also the speech defect which consisted of difficulty in finding the right words, so he could not say what he wanted to say. The noise persisted and he later noticed double vision when looking to the left and blood vessel enlargement and prominence of the left eye ball. The eye symptoms have increased gradually and cause disability. He has no headache or other symptoms. His past history is negative concerning present illness. He had pneumonia 6 years ago. His mother and one sister died of heart disease. He is married and has no children.

Examination revealed a well developed young man with moderate left exophthalmos and marked injection of the veins of his left eye (Fig. 9). Slight pulsation could be detected in this eye, and there was a paralysis of the left external rectus oculi muscle. With a stethoscope a rather loud vascular bruit could be heard over the left side of his head, most prominent in the left temple and mastoid regions. It could be heard faintly on the right side, and was stopped by compression of the left common carotid artery. Prolonged carotid compression produced no signs of cerebral anemia. Ophthalmoscopic examination showed marked dilatation of the retinal veins (Fig. 10). His vision was normal, pupils equal and regular, reacted to light and accommodation. General physical and neurological examination was otherwise negative. There was no carotid dilatation or cardiac enlargement. Urine, blood, and Wassermann tests were negative.

The left common carotid artery was compressed by means of a collar pad (Fig. 8) with increasing frequency and duration for a period of 3 weeks to insure the greatest possibility of adequate anastomotic circulation or anastomosis closure. He was able to maintain compression for 1 hour periods several times daily with no symptoms of cerebral anemia. Dilatation of the right temporal artery during compression was noted. There was very little improvement in the bruit or the eye symptoms after this course of carotid compression and the left common carotid artery was ligated March 29, 1932. Thirty minutes time under

temporary ligation were allowed to elapse before the wound was closed. No disturbing cerebral signs followed the ligation. The vascular bruit was gone and there was prompt improvement in the eye symptoms. He was dismissed April 5, 1932. When next seen, May 5, 1932, there still was considerable enlargement of the conjunctival blood vessels and proptosis of the left eye. The left sixth nerve paralysis and diplopia had practically disappeared. A vascular bruit could be heard by the patient only when lying down, and could be heard faintly with stethoscope over the left temple. There was visible pulsation over the left external carotid artery beneath the angle of the jaw and a vascular bruit could be heard here. These findings indicated a persistence of the arteriovenous opening with increased reversed circulation through the external carotid into the internal carotid artery above the ligation. It was recommended that he return to the hospital for internal carotid ligation and he was re-admitted June 8, 1932. The left internal carotid artery was ligated under novocain anesthesia June 14 and he left the hospital June 17, entirely relieved of the vascular bruit and with improving eye symptoms. When seen again on September 7, 1932, his left eye still presented some enlargement of the conjunctival veins and a little fullness of the upper lid (Fig. 11). There was no appreciable exophthalmos and no sixth nerve paralysis. The vessels of his neck were definitely enlarged and pulsated, particularly on the right side. A vascular bruit could be heard over them but no bruit over the head. He was aware of a bruit only occasionally when lying down. The oxygen content and capacity of the left internal jugular blood showed an oxygen saturation of 86 per cent, while the right internal jugular blood was 68 per cent, the arm veins blood 36 per cent. These tests confirmed the clinical signs of a persisting arteriovenous fistula but with improvement over initial condition. The low figure for oxygen saturation in arm blood might be explained from evidence of an old thrombophlebitis in both arms.

The case presents the typical syndrome of traumatic carotid-cavernous sinus arteriovenous fistula. Prolonged common carotid compression probably was unnecessary although the dilatation of the opposite temporal artery during compression indicated a stimulation of compensatory circulation greater than that produced by the arteriovenous fistula alone. Recurrence of disturbing symptoms after common carotid ligation necessitated later internal carotid ligation, but still with an incomplete cure. If his symptoms increase again further ligation may be necessary.

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LOW BACK PAIN

A NEW EXPLANATION OF THE PATHOGENESIS AND THE TREATMENT

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MANY cases of low back pain cannot be explained on the basis of organic changes in the back or as referred pains from disease in the pelvic or abdominal organs. The symptoms in these cases are due to a disturbance in function. This condition is called functional insufficiency.¹ The insufficiency is primarily in the muscles and is a condition in which apparently normal musculature is not equal to the demand placed upon it. This condition arises whenever the load is too great or the muscles are too weak. It is the purpose of this paper to show that such a condition frequently causes low back pain. A comparison between the symptoms of muscular insufficiency anywhere in the body and those found in low back pain shows that they coincide in character and in their mode of development.

The most common complaint in cases of muscular insufficiency or strain is an ache and tired feeling. The ache at first is relieved by rest. Later ordinary rest is inadequate and the ache becomes constant. Furthermore if a muscle has been strained and is rested, and then put into use again the symptoms of soreness and stiffness are added. Muscles that are used in weight bearing when fatigued, permit their load to be transmitted directly to the joints around which they act. These joints then become strained and the ligaments of these joints become unduly stretched. Clinically this is expressed by a sensation of localized pain often described as burning in character. If the ligamentous strain is prolonged, an inflammatory reaction may result. The symptoms of muscular insufficiency briefly summarized are therefore (1) intermittent ache and tiredness (2) stiffness and soreness (3) constant ache (4) localized boring pain near a joint—when the function of the muscles includes weight bearing and (5) symptoms of inflammation.

The physical findings of muscular insufficiency vary somewhat according to the number of parts involved. The first is muscle tenderness, which may be severe enough to prevent the patient's resting on the involved muscle. Second localized areas of tenderness can be demonstrated about the joints when the ligaments have become strained secondarily and third, deformities are

present in the form of altered posture when the strained muscles carry a load for example there may be pronation in the foot and valgus in the knee or in growing children there may be poor posture and adolescent scoliosis.² In an adult there may be poor posture.

In a review of 50 cases of insufficientia muscularis it seems that the symptoms and findings of low back pain in particular coincide with those described generally for muscular insufficiency. In these 50 cases the first symptom was almost invariably a low backache. This ache most frequently occurred in the dorsolumbar area and was usually associated with a feeling of fatigue. It could not be localized at any point, it would come and go and was relieved by rest. It was made worse by sitting or standing for a long time. This ache was not severe enough to require medical advice but gradually, over a period of many months, it grew worse. A burning pain could be localized at the lumbosacral angle or over the sacro-iliac joint. These areas were sensitive to pressure. The back felt stiff and sore on getting up in the morning. Periodically acute attacks of pain occurred. These came on after a sudden movement, upon lifting in the bent position, or upon first getting up in the morning. The sharp pain lasted several days. The back seemed to grow progressively worse as the years went by.

The physical findings during an acute attack included muscle spasm in the lumbar area. In some cases there was a list to one side. Active motion was limited. Lasgue's sign was positive when the sacro-iliac area was tender the normal lumbar curve was obliterated. After the acute phase subsided the muscles relaxed and the tone seemed below normal (hypotonia). The lumbar curve became accentuated to form a lordosis the shoulders drooped forward and the chest was depressed the abdomen was prominent with a tendency to be pendulous. With the exception of the cases of long standing which showed osteoporosis as described by Schanz³ and named by him "insufficientia vertebralis," the X-ray findings were negative.

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¹Hughes, P. *Principles of Orthopaedics*. Jena. Gustav Fischer 1903, pp. 249-254.

The symptoms and findings can be explained on a basis of muscular insufficiency. The first ache and tired feeling are due to fatigue of muscle. The power of recuperation in the muscle permits recovery by rest, but gradually the insufficiency increases, next, the ligaments become strained (Magnuson¹). The points of mechanical strain are the lumbosacral angle and the sacro-iliac joints. The strain can cause enough local irritation in these areas so that rest for several days is required before the inflammation subsides. Repeated or continuous strains result in a loss of strength and power of recuperation. The ache becomes constant and the ability of the muscles to function decreases. The back can no longer retain normal posture. Deformities occur, the normal spinal curves are exaggerated to form a lumbar lordosis and a rounded dorsal kyphosis, the shoulders are stooped, the chest is depressed and the abdomen sags and becomes prominent. The back is weaker and is susceptible to acute strains. A sudden twist or heavy lifting causes a sharp strain of the ligaments. The local irritation sets up a reflex muscle spasm with limitation of motion. When the inflammation is in the sacro-iliac joint a protective list results. The muscle spasm in the lumbar area obliterates the normal curve and causes a flat back. Rest relieves the irritation but at the same time prolonged rest tends toward weaker musculature. This explains the progressive increase of symptoms.

Further proof that muscular insufficiency causes low back pain was obtained by the therapeutic test used in the author's 50 cases. This system of therapy was directed against the insufficiency and was used over a period of 7 years. In a review of these cases it was found that low back pain was relieved or cured as soon as the muscular insufficiency was improved or cured. The treatment, which consisted first in relieving the complaint, second in correcting the deformity and third in re-establishing strength was conducted in the following manner.

The chief complaint which brought the patient in for consultation was usually an acute attack of pain. The patient was put to bed with Buck's extension fastened to both limbs (from 6 to 10 pounds is sufficient weight). Local heat was applied to the back by means of an electric pad during the time the patient was in extension. This treatment was continued for from 3 to 10 days until the muscle spasm had subsided. A small pillow was slipped under the lumbar area and gradually the normal lumbar curve was re-

covered. As soon as the muscle spasm subsided the patient was turned on his abdomen and moist heat was applied to the back. A moist towel covered the back while reflected heat was used for 30 minutes. Twenty minutes of massage followed, with an oil used to assure a soothing stroke. The heat and massage were continued until all inflammation was relieved, that is, until the local tenderness had disappeared. As a rule 2 or 3 days sufficed.

The deformity was then corrected in an upright extension frame and the correction obtained was retained by means of a plaster-of-Paris cast. A cross bar was fastened to the anterior side of the extension frame at the level of the symphysis pubis. The pelvis was fixed to this transverse bar. The head was drawn upward in a Sayre extension apparatus. The hands were allowed to hold to the overhead bars. Full extension was gained and the cast was applied over stockinette and over a single layer of sheet wadding. The crests, sacrum and lower dorsal vertebrae were covered by a quarter inch thickness of felt pad. A 6-inch width of fast setting (specialist) plaster was rapidly and snugly molded to fit the form exactly. As soon as the plaster had set, the overhead extension was relieved and the cast trimmed. A window in front allowed room to breathe and a space for food. Enough plaster was removed in the axilla to allow free use of the arms. In the back the jacket was trimmed to leave the scapulae free. In this way correct posture was obtained. Since the cast had been put on in extension it acted as a support to protect the weak and strained muscles. These muscles could now be built up by graduated exercises. If the muscles were very weak the treatment was like that of the convalescing anterior poliomyelitis patient, or it might be compared to that of an athlete starting training. A 5 pound sand bag was balanced on the head. Dumb-bells and setting up exercises were prescribed. General exercises as well as exercises for the back and abdominal muscles were encouraged. In a comparatively short time as a result of these exercises, the cast became loose. A new cast was applied to the trimmer figure. The length of time that a cast was worn varied greatly with the individual case, the severity of the weakness, the amount of normal strain and the co-operation of the patient are all factors. The course of treatment varied from 5 weeks to 6 months. Every case showed a definite improvement with this treatment. The symptoms were invariably relieved with the wearing of the cast. All those patients in whom normal strength was regained remained well.

¹Magnuson, Paul B. Reasons for lack of positive roentgen findings in many cases of low back pain. *Am. J. Roentgenol. & Rad. Ther.* xli, No. 1, pp. 13-5.

The 5 following cases are typical illustrations of low back pain caused by muscular insufficiency and show the benefit derived from the treatment described.

CASE 1. Muscular insufficiency acute phase post sacro iliac strain, complication—osteitis.

G. S. male, 38 years of age, a machinist, had his back wrenched in 1928. Eighteen months later he began to have a dull ache in the lumbosacral area. This grew worse until he had a sharp pain in the lumbosacral and sacro iliac areas. In the spring of 1931 heavy lifting made the pain much worse. At this time he also developed a pain along the course of the right sciatic nerve. The pain interfered with his sleep. He lost 10 pounds, felt tired and weak. He was unable to work.

He obtained some relief from rest in bed and local heat for the pain in the lower extremity. The pain recurred when he was up, particularly if he tried to work. He was treated for arthritis with intramuscular injections. He resorted to osteopathic and finally to chiropractic treatments. He wore a sacro iliac belt for 6 months without benefit. He was then fitted with a Taylor brace which he wore for 6 months. The brace gave some relief at first. As his condition grew worse a fixation operation was advised. In August, 1932, he was finally referred by a former patient who had had a similar condition.

Pain was present over the sacro iliac joints with movement. Flexion and lateral motion of the spine were limited. The Lasègue sign was positive, the left more definitely than the right. There was tenderness over the sciatic notch, and the muscles of the left calf were tender to deep pressure. The abdominal muscles were weak with poor tone. Rigidity was present in the lumbar muscles, and there was an absence of a normal lumbar curve.

The cast treatment was applied. Relief from the support was immediate. The patient was able to return to work. The support was removed after 3 months. He has had no recurrences.

CASE 2. Muscular insufficiency and acute sacro iliac strain.

E. R. 43 years of age, a restaurant proprietor complained of pain in the back. Six weeks previous to his examination he lifted a sack of flour and injured his back. He felt sharp pain in the lumbosacral area. On the advice of a surgeon he tried rest in bed, but the pain persisted. It was severe and almost constant. The patient became irritable and very nervous. An operation was then suggested.

The past history revealed that the patient had suffered from backache for about 6 years. The ache was in the lumbar as well as over the sacro iliac area, and was always worse after prolonged standing. Because of the pain and weakness in the back and his general fatigue, he gradually gave up golf and other sports and was forced to discontinue his business activities almost entirely.

Examination showed a well developed man who walked with effort. His lower back was held rigid. He leaned forward at all times and listed slightly to the right. The lumbar curve was obliterated. Both sacro iliac joints were tender to pressure, especially the left. The abdominal muscles were weak and flabby and the lumbar muscles rigid and tender.

Hospitalization was advised and the patient was put to bed with a bilateral Buck's extension. An electric pad and, later, a baker gave heat to the sacro iliac area. After 7 days, relaxation was obtained. A body jacket of plaster of Paris was applied with patient in the vertical extension frame. Relief was immediate. He walked straighter and

moved with a feeling of security. At home he carried out a series of graduated exercises. After 3 weeks the cast was removed and a light, re-enforced corset was used.

The patient took an automobile trip and after 3 weeks discarded all support. He continued his exercises, started swimming, and then golf. He is now back at work and feels fit in every way. There has been no recurrence of any pains since he left the hospital.

CASE 3. Muscular insufficiency with recurrent sacro iliac strain.

Mrs. A. H. 35 years of age, a stenographer was referred on account of a deep seated pain in the back. This was her third attack. The pain was localized in the left sacro iliac region, but when severe was more generalized. Relief was obtained by lying down for 5 minutes but there was a recurrence of pain on getting up. The patient was unable to bend forward or sideways; if she jumped up quickly and took a step she had severe pain, she faints twice. She was unable to rest back in an overstuffed chair. After prolonged standing a throbbing pain was left down both thighs.

The first attack, several years ago, came on while attempting to move a piano, and lasted several days. She thought it was lumbago. The second attack occurred in February, 1929, and kept her at home for 3 days; the pain lasted from 3 to 4 weeks. The third attack occurred in June, 1930, on this occasion she was at home for 3 days but felt crippled for a month.

The last attack began in February 1931. She was at home for a week. A dull pain persisted. She got better but had recurrences. This attack came on after lifting a suit case. She received medical care—tablets by mouth, injections to the back, one devitalized tooth was removed, local heat gave temporary relief. Each attack was brought on by lifting. A chronic strain due to prolonged sitting and standing was also present.

Examination showed a thin, blood woman. The tendons were removed. The Hinton test on the blood serum was negative. The chest, abdomen, and pelvis showed normal findings. There was tenderness and pain rather localized over the left sacro iliac. The lumbar muscles showed marked muscle spasm. Motion was limited about 10 degrees in all directions. Lasègue's sign was positive, the left more so than the right. Bending forward increased the pain. There was a slight list to the left. The X-ray showed a straight lumbar spine with no normal curve and no osteoarthritis.

A plaster jacket was applied in overhead extension frame. The list was corrected. After 10 days the cast was changed. The position was improved. Correction to normal was possible. The new cast was worn for 6 weeks and then removed. A re-enforced cloth corset was worn for 2 months. Periodic rest periods were prescribed during the first 3 weeks. Graduated exercises were increased by the use of dumb-bells, prescribed walks, and setting-up exercises. Immediate relief from the pain was obtained. The general strength improved. There has been no recurrence.

One year has elapsed and the patient has remained free of all symptoms.

CASE 4. Muscular insufficiency with chronic sacro iliac strain.

O. H., 34 years of age, an intelligent business man, came in because of a backache of 4 years duration. He had wrenched his back boarding a train and had immediately felt a sharp pain in the lower part of the back. The following morning he was unable to move and remained in bed for several days. He then had four osteopathic treatments and was relieved for 3 months. At the end of which time he had a similar attack while in swimming. Again he obtained temporary relief by rest and osteopathy, but the

pain recurred often in such sudden and severe manner that he had a constant feeling of insecurity. The condition progressed until any sudden or unguarded movement caused intense pain. After a year of this he was conscious of stiffness and soreness in the lumbosacral and sacro-iliac areas, and on awaking fatigue and backache. He gradually gave up all exercise, became overweight, noticed increasing tendency to sway back, and more frequent and severe attacks of sharp pain.

Examination showed a well nourished, well developed male some 30 pounds overweight. Posture was poor the abdomen pendulous, all normal curves were increased. There was a hypotonia of the musculature, particularly in the back. The abdomen and back had an increased subcutaneous adipose layer. Motion of the spine was free.

X ray showed increased lordosis and a suggestion of hypertrophic arthritis in the lumbar area. This latter however was not definite.

Treatment was entirely ambulatory. A supporting cast was applied, which gave immediate relief. The cast was worn for 3 months and graduated exercises were carried out at home. After discarding the cast the patient wore a form-fitting re-enforced corset while at work for a period of 3 months. During the treatment the patient's waist measure was reduced 3½ inches. His general health has never been better. He has regained his normal weight, a loss of 20 pounds. He now swims, plays tennis, and can carry out a day's work, often 10 hours at a stretch.

There has been no recurrence of the attacks since his discharge.

CASE 5. Muscular insufficiency of the back, acute phase sciatic scoliosis.

L. K., 39 years of age, a crane operator had had pain in his back for 5 years. This began in 1923 after bending over and lifting. The sharp pain subsided after a few days. Gradually he began to have more trouble with his back. He became more susceptible to strains and each attack was worse than the last. At first he had periods in which he was free of symptoms. For 3 years the pain was con-

stant and was increased by work so that it was necessary for him to discontinue work. The pain low in the back was severe at times there was a constant ache in the muscles of the entire back and the hips. For 1½ years he felt pain in the right lower extremity. He had walked with a peculiar gait for 1 year.

He was given a series of osteopathic and chiropractic treatments without relief. Then he had medical care, was in a hospital for 6 weeks without appreciable benefit. Braces of various types were tried but were discarded. He was treated at various clinics for sciatica. He came for relief of his pain in 1928 to the Out Patient Department.

The patient walked with a marked list and leaned forward. He was emaciated and irritable. Motion in the spine was lost except for a few degrees. The lumbar muscles were rigid. There was tenderness over the sacro-iliac areas and the lumbosacral angle. Lasague's sign was more positive on the right than on the left. The posterior surfaces of the thigh and calf were sensitive to pressure. The abdomen had a tendency to be pendulous.

He was treated by the cast method. Preliminary hospitalization was not feasible. The cast was changed three times at intervals of approximately 3 weeks until correction was obtained. He wore a cast for 6 months. He resumed work 2 months after treatment was begun. When last seen on May 3, 1932, he had been free of symptoms for 4 years. During this period he has been able to do heavy work, has gained 27 pounds, and states that he has never felt better in his life.

CONCLUSIONS

1 A number of cases of low back pain owe their origin to muscular insufficiency.

2 In these cases a cure of the muscular insufficiency resulted in a cure of the condition called low back pain.

3 A method of treatment based on these conclusions has met with success.

TUBERCULOSIS OF THE FLAT BONES OF THE VAULT OF THE SKULL¹

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TUBERCULOSIS of the flat bones of the vault of the skull is an uncommon condition but it is not rare.

Ried of Erlangen a German surgeon has the honor of being the first to recognize the condition clinically and of making the first clinical report in the literature. His article appeared in 1842 and was based on two cases which were under his observation in 1838. Isolated cases were reported during the next 38 years. In 1880 it was again drawn to the attention of the profession by two important articles, one by Volkmann based on 12 personal observations, and one later the same year by Kraske. Both of these German surgeons recognized the fact that the disease tends to perforate the entire thickness of the skull. Volkmann used the appellation "Perforating tuberculosis of the vault of the skull" and stated that in all 12 cases seen by him there was a sharply circumscribed disease in a single area in the skull, in all caseation and necrosis of the entire thickness of the skull, so that on the inside the dura mater on the outside the periosteum, was lifted away by pus and the skull was perforated in a small sharply circumscribed area of lentil to cherry size. He emphasized the rather vague symptoms, the fact that a cold abscess eventually develops and that his experience convinced him of the need of radical surgical treatment that a bean sized sequestrum is often present and can be easily removed that tuberculous granulations are present on the outside of the dura but can be easily curetted off and that where radical removal of all tuberculous tissue is accomplished rapid and definitive healing occurs. Koenig in his treatise on surgical pathology which appeared in 1888 devoted an entire chapter to tuberculosis of the vault of the cranium, and was the first to describe the progressive infiltrating type.

The most numerous contributions, however are by French authors. Ganglophe's description (1887) of perforating tuberculosis of the skull is a classic. Pelletier's thesis (1910) and Joutard's thesis (1926) are the most exhaustive contributions extant.

My report is based on a study of 250 cases which have been reported in the literature and 3 cases which I have observed personally—or a total of 253 cases.

While the condition is uncommon, it seems likely that it occurs more frequently than the number of cases reported in the literature would indicate. Wieting and Ralf Effendi (1903) report having seen 10 cases in a single year and Villemain (1901) 11 cases in 2 years. Three cases have come under my observation in the last 7 years, 2 of which had been seen by other physicians without the correct diagnosis having been made.

After one has become familiar with the condition the diagnosis is easy as a rule for the clinical picture and the roentgenographic findings are usually typical if not pathognomonic. The indications for treatment are definite—prompt, radical surgical intervention with complete removal of all diseased tissue. Once this is accomplished healing is usually rapid and permanent.

Tuberculosis of the bone in general, usually begins in the cancellous portion of the bones involved. It is because there is little cancellous bone in the flat bones of the vault of the skull that these bones are so seldom affected by tuberculosis, just as is true in all the other flat bones which contain little cancellous bone. However when the cranial bones are affected the disease ordinarily begins in the cancellous portions of the diploe.

ETIOLOGY

Incidence. Of 1,385 cases of bone tuberculosis observed in the Children's Hospital of Basel from 1868 to 1908 19 or 1.37 per cent involved the cranium (Pare!, quoted by Pellitier). Claeys, in 1910 reporting the 3,750 cases of tuberculosis of bone observed in Broca's service in the Hôpital des Enfants Malades, found 47 cases of tuberculosis of the vault, or 1.25 per cent. Berck (quoted by Joutard) believes the proportion to be about 1 in 500 or 0.2 per cent.

Age. The condition occurs most frequently in early childhood and one-half of the cases occur before the tenth year. Three-fourths of all cases occur before the twentieth year. The disease is not one of early infancy probably due to the small amount of cancellous bone present in the flat bones of the vault at this early age. It is an affection of later infancy and adolescence. The condition is much less frequent in adults. Rarely it may even occur in old age (Raymond's case).

¹Read before the Western Surgical Association, Denver, Colorado, December 4, 1931.

An analysis of 181 cases from the literature and my 3 cases, or 184 cases, shows the following age incidence

| Age | Cases |
|------------------|-------|
| Less than 1 year | 5 |
| 1 to 10 | 85 |
| 10 to 20 | 49 |
| 20 to 30 | 15 |
| 30 to 40 | 15 |
| 40 to 50 | 6 |
| 50 to 60 | 10 |
| Over 60 | 1 |
| | 184 |

Influence of pre-existing tuberculous lesions elsewhere in the body The condition is almost always secondary to tuberculosis elsewhere in the body. A study of all reported cases shows that the overwhelming majority are preceded by either pulmonary tuberculosis, tuberculosis in other bones, lymphatic glandular tuberculosis, or tuberculosis elsewhere in the body.

Often there are multiple foci before the cranial lesion develops, but the condition is not a manifestation of a serious general tuberculosis, as Koenig supposed. Although multiple tuberculous lesions elsewhere in the body often co-exist, these patients can often be completely cured. It may, however, occur late in an advanced case obviously incurable as in my Case 3.

Volkman found a co-existing tuberculous lesion elsewhere in the body in only 1 of his 12 cases. This is most unusual. Wieting and Raif Effendi in 10 cases found tuberculous lesions elsewhere in the body in 6 cases. They believed it was oftenest secondary to tuberculous cervical adenitis. Delamare and Connor noted this association in 11 of their 15 cases. Reber found co-existing lesions elsewhere in the body in 23 of his 24 cases. This is what one would expect and Pelletier considers this co-existence as almost constant. Most commonly the antecedent lesion has been in the lung and the skull lesion has developed late in the case. It may occur in the course of a slowly developing or even healing case of pulmonary tuberculosis. The lungs may be free from demonstrable tuberculosis, as was true in all 3 of my cases when seen originally. The only demonstrable lesion may be in the bones or joints, lymph glands, especially the cervical lymph nodes or in the skin as in a case reported by Lenormant, in which the patient had suffered for 6 years from lupus of the nose. In many cases there may be tuberculosis in several bones or joints without any demonstrable pulmonary lesion. This was true in my Case 1 and Case 2. Such cases suggest infection with a strain of

tubercle bacilli that show a predilection for the osseous system. The primary focus of tuberculosis is usually distant from the vault though Bergman pointed out the frequent co-existence of tuberculosis of the bones of the face orbit or malar bones.

Cases are reported in which the focus in the vault of the skull is primary, though it is always possible that a focus existed elsewhere in the body, perhaps concealed as in some hidden lymph node.

Influence of trauma That trauma seems to play an important rôle in the development of tuberculous lesions was pointed out by Max Schuller in 1878. Volkmann, in 1880, called attention to the etiological importance of trauma in tuberculosis of the vault of the skull. Other observers, later, reported cases developing after a blow on the head (Israel, Frosse, Estor, Joutard). Reber, in 1907, reported 7 cases out of 24, or 29 per cent. Perhaps trauma may be a factor in the high incidence in young children and the greater relative frequency in boys. Pelletier believes that the great majority of cases develop without such a local cause, and Joutard without going so far as to deny a possible etiological relationship states that he believes trauma may light up a focus, which was latent up to that time. In my Case 1, the etiological relationship of trauma and localization seems definite. In that case each of the four bone lesions, the one in the metacarpal in the rib, and the two lesions in the vault of the skull definitely began soon after a local trauma, and even the parents suspected an etiological relationship (Fig. 1).

Influence of syphilis It is difficult to determine how much influence syphilis has in determining the development of tuberculosis of the vault of the skull. It is not rare to find the two diseases co-existing. This was true in 4 of Raymond's 10 cases.

Influence of sex Sex does not seem to play much of a rôle except, perhaps as mentioned relative to trauma. Males seem more frequently affected. Labhardt's statistics (quoted by Pelletier) showed 60 per cent in males and 31 per cent in females.

PATHOGENESIS

The infection most commonly reaches the skull bone through the blood stream and usually from a distant focus. Infection may also occur via the lymphatics. Wieting and Raif Effendi believed that in their 10 cases it oftenest occurred secondary to tuberculous cervical lymphadenitis, the primary portal of entry being from the tonsils.

Most commonly the antecedent lesion had been in the lung and the skull lesion has developed late in the case of the pulmonary tuberculosis. In other cases, there has been a preceding bone or joint tuberculosis. The skull lesion is almost always secondary. Rarely the infection may be by direct extension from tuberculosis of an adjoining bone, as the temporal or the frontal bone, by extension of tuberculosis in the orbit. In one of Israel's cases the focus in the skull seemed to be primary resulting from infection of an open scalp wound. Reber suggested that primary tuberculosis of the cranial bone might be explained by direct passage of the bacilli through the nasal mucous membrane without the development of any tuberculous lesion in the nose, localizing in a *locus minoris resistendiæ* resulting from a blow on the skull. Cases of primary tuberculosis of the skull bones are, apparently, not at all rare. Koenig estimated that about one fifth of all cases are primary. This percentage is probably much too high.

When the bone infection is hæmatogenous in origin which is the usual mode the *initial localisation is in the vascular cancellous bone of the diploe*. Gangolphe whose description of tuberculosis of the vault of the skull though written in 1887 still remains a classic considered this localization the rule.

In a few cases especially in infants the disease begins in the periosteum and there is usually only a superficial erosion of the outer table, as in one of Raymond's cases, in which cure was affected by superficial curettement.

More rarely it begins in the dura mater attacking the bone secondarily and to a lesser degree, as an erosion of the inner table. Apert reported such a case in 1898 and Sorrel Barret and Mazuil reported one in 1923.

PATHOLOGICAL ANATOMY

Analysis of statistics from the literature and my 3 cases, shows the relative frequency of the bones affected

| Bone Involved | Cases |
|---------------|-------|
| Frontal | 86 |
| Parietal | 85 |
| Occipital | 18 |
| Temporal | 6 |
| | — |
| | 306 |

Thus it is obvious that the two bones most often affected are the frontal and the parietal. This is probably because they contain more cancellous bone than any of the other flat bones in the vault. Perhaps, also they are the most exposed to trauma.

The occipital and temporal are much less often involved.

Wieting and Ralf Effendi stated that at least in the case of infants, the disease does not affect the sutures of the skull. The bony sutures do not, however present an absolute barrier to tuberculous invasion, either in the adult (Raymond's case) or even in the infant (Reber's case).

Volkman believed that tuberculosis of the vault was characteristically limited to a single focus. His observations, however were based on too small a series of cases (12) and his opinion, which is still quoted in the literature (*Handbuch der praktischen Chirurgie*) is no longer tenable. Reber in 1907 found 37 cases in which it was present in more than one focus and in his own 24 cases, 10 showed multiple foci involved—that is, in 41.6 per cent. My Cases 1 and 2 each showed two distinct and absolutely independent foci. My Case 3 showed one focus only. We now know that tuberculosis of the vault is frequently present in more than one focus and that, contrary to the belief of St. John these foci are often entirely separate and distinct one from the other. This is not surprising since the skull involvement is, as a rule due to a hæmatogenous infection. My Case 1 presented two distinct and absolutely independent foci as was proved by operation (see case report). St. John however (1921) is of the opposite opinion. He states "It has been the custom to regard each perforation as representing a separate focus. This is certainly a mistake."

I have expressed my doubts as to the actual existence of two separate forms of tuberculosis of the cranial vault—the one represented by a localized necrosis, known as the *perforating form* (Volkman, Gangolphe) and the other by *diffuse progressive infiltration* (Koenig) in spite of the distinction having become almost classical. He goes on to point out that his opinion is that the conception of two separate foci is an erroneous interpretation of the pathological findings, that in Menard's case and one of his own, presenting an exceptional number of perforations, the skull was infiltrated to a remarkable degree, and that the number of perforations may not be out of proportion to the extent of the disease. No one will deny St. John's contention that in such cases as this one of his and in Menard's case each perforation does not represent a separate focus. Lenormant (1920) states the facts accurately when he writes "We must clearly distinguish when we find abscesses fistulae or multiple perforations at a distance one from the other between cases in which there are really independent and completely separated foci, and those—probably the

more frequent—in which these abscesses or fistulae are only the outward expression at diverse points on the cranial vault, of a vast focus, diffuse and yet unique, having its seat in the diploe or between the bone and the dura. Erdheim¹ 1932, has contributed a classic article on the pathology of tuberculosis of bones in general and of the skull in particular.

Two types of the disease are generally recognized

I The circumscribed (perforating) type (Volkmann, Gangolphe)

II The diffuse progressive type (Koenig)

I *The circumscribed (perforating) type* This is the most frequent form

Most cases met with clinically are not seen until the process has penetrated both tables and at the site of the perforation, there is present a typical cold abscess, which elevates the soft parts as a prominent swelling. This type is characterized by a round usually punched-out looking defect through the entire thickness of the skull. Volkmann (1880) considered this as characteristic and used the appellation Perforating Tuberculosis of the Skull, but his conclusions were based on too small a series of cases—only 12.

Lenormant objects to the appellation perforating type, since not all cases perforate. He suggests, instead the term 'circumscribed type' in contrast to the rarer "diffuse progressive type. In the great majority of cases, the initial focus begins as a localized area of granuloma formation within the diploe, which slowly develops in size and presents the typical, rarefying osteitis seen in the other flat bones. It is slowly progressive and causes very little reaction in the adjoining bones. The tuberculous granulations occupy the spaces in the spongy bone the capillaries become obliterated and the bone trabeculae gradually disappear and are replaced by the tuberculous granulation tissue. When this process proceeds slowly the affected bone merely becomes converted into bone sand, without the formation of a true sequestrum. When the vascular change is more rapid and the absorption of the trabeculae has not time to take place multiple small sequestra, or one large sequestrum may result. The focus in the diploe tends to spread simultaneously toward the two surfaces of the bone, but usually not equally. The internal table is more easily affected by the disease than the external table and all reported cases in which the disease began in the diploe show greater destruction of the internal table than of the external table. This is just the opposite of what is seen in syphilitic osteitis.



Fig. 1. Wm. D. Case 1, before operation. Note well nourished appearance of child aged 5 years. Black arrow points to cold abscess over perforation in parietal bone. White arrow points to cold abscess over tuberculous carious eleventh rib.

The earliest cases (Chipault) show involvement of the diploe only. The external table is intact, the internal table is practically so but between the two the bone is exceptionally soft and friable. The involved diploe is replaced by tuberculous granulations which can be detached with almost no bleeding. In some places these have penetrated into the internal table but this obviously is only secondary. Very few cases have been seen so early.

Most cases are not seen until the process has penetrated both tables and this circumscribed (perforating) type is characterized by a round usually punched-out looking defect through the entire thickness of the skull. The only portion of affected bone remaining is ordinarily merely a small sequestrum, a few very small sequestra or, in some cases only bone dust. The periosteum and bone surrounding the perforation look entirely normal up to the very edge of the perforation. The bone shows no hypertrophy and there are no osteophytes. There is however a narrow zone of rarefying osteitis immediately about the defect. The perforation is round in the majority of cases, less often oval and sometimes more or less quadrilateral with rounded corners. The diameter may vary from a few millimeters to a finger breadth or wider. Most often it is almost the size of a dime, or a little smaller. In all 3 of my cases the defects



Fig. 2. Anteroposterior roentgenogram, Wm. D. Case 1 taken April 9, 1925, before operation, showing circumscribed perforating lesion in left frontal bone.

were punched out and there were no sequestra. In Cases 1 and 2 there were two defects: one in the left frontal and one in the left parietal bone. There was but one defect in Case 3. All five defects were of approximately the same size about the size of the tip of the little finger. Some cases, like Volkmann's contain an almost round sequestrum nearly completely filling the defect with a little pus between its margins and that of the perforation. This pus often pulsates showing that the perforation is complete. Such a sequestrum can easily be removed with a periosteal elevator as a rule in contrast with the syphilitic sequestrum.

In some cases the superficial opening of the perforation may be very small, the sequestrum consisting chiefly of the internal table which is ordinarily affected over a larger area and it is sometimes impossible to remove the sequestrum through this small outer opening until after cutting away the margin with a bone-cutting forceps.

Pelletier has pointed out that in cases seen earlier that is, before complete perforation has taken place, there is no well marked furrow separating the affected bone from the surrounding healthy bone, and while it may be present in some places the transition from healthy to diseased bone is imperceptible, and that in still earlier cases, the external table may show very little change, close examination showing only an area of bone more yellow and duller than normal.

Where perforation is complete, and this is the

rule as in all 3 of my cases, the tuberculous granulations extend down to and lie on the surface of the dura, do not penetrate it, and are not very adherent to it.

In some cases there are multiple foci of involvement, as in my Cases 1 and 2. Here, each focus presents similar findings to those just described.

Tuberculosis of the external table alone is some times encountered especially in infants (Villie min 1901). In these cases, when seen early the external table, instead of appearing smooth and pale is reddish riddled with small red points, and is softened. Below this thin layer the bone is of normal consistency. In even earlier cases, there is no discoloration of the diseased area of bone, but on passing the finger over the area revolved a rough unevenness is perceptible though not visible while the surrounding bone is smooth.

Sometimes a sequestrum is present but it is lamellated and irregular as an exfoliation of the superficial portion of the external table. It does not involve the entire thickness of the external table and a mere stroke of a curette encounters bone of normal resistance.

Tuberculosis of the internal table only is much rarer. Such a case, found at autopsy was reported by Apert (1908). During life there was no clinical evidence suggesting a tuberculous lesion of the skull.

II. *Progressive infiltrating tuberculosis of the skull* Koenig (1888) was the first to describe the progressive infiltrating type. This type is much less frequent, and Koenig considered that it was rare.

This type, also begins in the diploe, but shows a peculiar tendency to invade the diploe and the internal table in a progressive manner and to spread over the vault to an unlimited extent and to form an extensive sheet of tuberculous granulations between the dura and the internal table, in the form of a tuberculous pachymeningitis externa. This sheet of tuberculous granulations results chiefly from extension of the disease through perforations in the internal table. Perforations through the external table also, may be numerous and widely separated. Lenormant (1920) makes the interesting suggestion that in some cases the disease may extend, not by spread of the disease in the diploe, but by means of the sheet of tuberculous granulations situated between the dura and the bone in the form of a tuberculous pachymeningitis externa that these granulations reinoculate the bone on its deep aspect and determine the formation at a distance from the primary focus, of fresh points of necrosis, and that these in turn may lead to independent

perforations of the entire thickness of the skull. He suggests this apparently as an alternative mode of invasion and does not deny the spread of the disease, in many cases through the diploe.

The serious nature of this type is due to the extensive area of the vault that may be involved in the process. The cranial sutures do not offer any bar to the spread of this type of the disease, as they do in the case of the commoner circumscribed form.

In these cases of the progressive infiltrating type very extensive operations to eradicate the disease are required often resection of several cranial bones being necessary.

Pearl resected an area 7 centimeters in diameter. Gaudiers and Bachman (1904) operated on a 10-year-old child with involvement of the parietal left temporal and a portion of the frontal bones and removed almost the entire wing of the temporal a large portion of the parietal, and an extensive portion of the frontal bone without reaching normal bone.

Lesions in the soft parts. The changes found in the soft parts are those seen elsewhere in tuberculosis of the bone, i.e., cold abscesses and fistulas. When a perforation has penetrated the outer table the periosteum is lifted up and transformed into a tuberculous membrane. So long as the periosteum remains unruptured the tuberculous abscess is limited by adherent periosteum, and when palpated through the scalp gives to the examining fingers the sensation of a hard or bony tumor. This was true in my Case 2 and led those who cared for the boy, before I saw him to diagnose the case as one of multiple myeloma.

After the periosteum ruptures, the tuberculous pus escapes below or into the muscles and finally reaches the skin. At this stage one finds a typical cold abscess, with definite soft fluctuation. This projects prominently and varies in size from that of a hazelnut to the size of a fist or even larger. Most commonly it is from hazelnut to cherry size. In some cases the abscess shows pulsations synchronous with those of the brain.

Early, the skin overlying the abscess is normal in color and temperature and is freely movable over the abscess. Later, the skin becomes adherent gradually it becomes thinned and bluish red, and finally shows the typical picture of threatening perforation. Unless operated on, perforation finally occurs and a typical chronically discharging tuberculous fistula develops.

It is rare for the abscess to migrate far from the bone lesion producing it. At times however it may spread for some distance due to gravity or because it follows planes of cleavage.



Fig. 3. Lateral roentgenogram taken April 9, 1925. Case 1. Upper arrows point to the circumscribed perforating lesion in the left frontal bone. The lower arrow points to the circumscribed perforating lesion in the parietal bone (left).

Quite often, if the lesion is in the parietal or temporal bone an abscess develops beneath the temporal muscle (as in my Case 1), lifts up the muscle and overlying soft parts, and spreads out in the muscle, which often becomes infected and softened and in the aponeuroses and it is longer before it reaches the skin.

Lesions of the endocranial soft parts. There is almost always a collection of tuberculous granulations of greater or less extent on the surface of the dura which in some cases may cover a considerable area of the vault, but it is much more rare to find an abscess between the dura and the internal table of the bone because these granulations show little tendency to soften and form pus. At operation it is rare that much pus escapes from beneath the bone. The tuberculous granulations may spread out radially over the dura from the site of the perforation, in finger like projections, as in my Case 3 (Fig. 15). These granulations are not very adherent to the dura, do not tend to penetrate it, and usually can be easily removed by gentle curetting. They may extend well beyond the limits of the bony necrosis. In a few cases they have formed a large, tumor like mass in one case the size of an orange and then may give rise to pressure symptoms like a tumor. The dura beneath the granulations is thickened bluish, and injected. The thickened dura tends to prevent infection of the underlying meninges and brain and for this reason tuberculous meningitis and tuberculous involvement of the brain are very uncommon, though cases have been reported. In the 223 cases collected there were only 10 cases

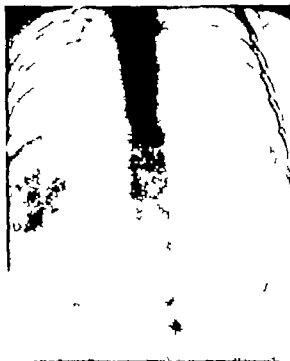


Fig. 4. Roentgenogram of chest. Case 1, taken April 9, 1936, before operation. N is the tuberculous cavity of the eleventh rib. Lungs are normal.

of tuberculous meningitis and only 5 cases of cerebral tuberculous.

SYMPTOMS

The appearance of a swelling on the head is usually the first intimation of the condition though in some cases this is preceded by headache which may be slight and transitory or less often it may be severe and more or less continuous. Headache is not a common symptom however but when present tends to be always located in the same area of the skull. If it is associated with a fixed localized point of tenderness in the same area it is more significant. In a few cases, there have been signs of cortical irritation with epileptic seizures and in a few other cases there have been signs of cerebral compression with tumor symptoms, but these are exceptional.

As a rule, attention is not drawn to the condition until a swelling makes its appearance. In cases seen early this is due to a subperiosteal abscess. At first this is only slightly elevated, round, firm and obviously fixed to the bone. It slowly enlarges and later may reach the size of a cherry. The skin and other soft parts are freely movable over it and the skin is normal in appear-

ance. The consistency is so very firm however that it is very easy to mistake it for a tumor of the bone.

Later after the subperiosteal collection has perforated the periosteum and the tension is relieved the cold abscess that results in the soft parts still retains its rounded form as a rule but it now shows definite fluctuation. At this stage the skin appears normal and is freely movable over the swelling which stands out prominently and resembles a sebaceous cyst. However careful palpation shows that while it is soft in the center the margins are firm at the base, and that here the swelling is attached to the bone. Thus it more closely resembles a cephalhematoma. Volkman mistook one of his early cases for one. The cold abscess gradually increases in size, but fixation at the base can always be made out.

In some cases the cold abscess may show decrease in size on pressure, due to continuity with the extradural space. In some cases the cold abscess shows pulsations synchronous with those of the brain.

Later the skin becomes adherent, inflamed, bluish-red, thinned, and finally perforates, and there is a discharge of typical tuberculous pus. If this has occurred, the diagnosis should be obvious. The perforation in the skin is very small in some cases and may spontaneously close, only to reopen later. A typical tuberculous fistula now forms and discharges indefinitely. In some cases the area of scalp that is ulcerated is very large as in my Case 3 and the dura covered with tuberculous granulations may be visible through the perforation in the bone.

DIAGNOSIS

In children a Mantoux test or a von Pirquet tuberculin skin test should be made. A positive test is of great significance in making a diagnosis in young children.

Roentgenograms usually clinch the diagnosis as they almost always show one or more circumscribed punched out looking defects in the bone. The bone about the defect appears entirely normal even up to the very margin of the perforation. This picture is typical of circumscribed tuberculosis of the flat bones of the vault of the skull. In some cases, as in my Case 3, the tuberculous granulations on the dura may cast a shadow beyond the area of bone defect. In the roentgenogram of Case 3 the shadows radiated like the petals of a flower (Fig. 15). If there is still any doubt as to the diagnosis, the swelling may be aspirated and smears, cultures, and a guinea-pig inoculation made.



Fig. 5. Anteroposterior roentgenogram of skull, Case 1 taken May 14, 1925. Upper arrows point to the operative defect resulting from the first operation. The black areas within this defect are shadows cast by the iodiform powder dusted on the dura at the time of operation. The lower arrows point to the operative defect resulting from the second operation. Here again one can see the shadows cast by the iodiform powder dusted on dura at time of operation.

DIFFERENTIAL DIAGNOSIS

1 *Gumma due to syphilis of the vault* probably simulates the condition most closely. Often both conditions are present in the same patient and both diseases affect the same bones of the vault. The negative Wassermann test is of great help, but does not necessarily rule out syphilis. Severe pain at night, a tendency to necrotic destruction of the scalp without much pus formation, and especially the roentgenological findings are characteristic of syphilis. Syphilis of the bones of the vault usually occurs in adults, much less often in children which is just the reverse of tuberculosis of these bones, which occurs most frequently in young children.

The roentgenological and local findings in the bone in syphilis is characterized by smaller and very large multiple areas of absorption which are not sharply circumscribed and alternate with areas of sclerosis and osteophyte formation. The skull presents a moth-eaten appearance. The skull is often thickened the surface uneven, and sequestra when present, are not easily removed.

2 *Acute osteomyelitis of the skull* is even more rare than tuberculosis and ordinarily offers no



Fig. 6. Lateral roentgenogram of the skull, Case 1 taken May 14, 1925. The upper arrow points to the operative defect resulting from the first operation performed April 20, 1925. The lower arrow points to the operative defect resulting from the second operation performed May 6, 1925. The black shadows seen within both bone defects are cast by the iodiform powder dusted on the dura at time of operation.

difficulty as its course is so acute and characterized by the usual symptoms of the disease: fever, pain, edema. Early bone changes occur but aspiration will show the causal organism usually staphylococcus.

3 *Chronic osteomyelitis of the skull* is unusual but it develops slowly and presents all the appearances of a cold abscess. Roentgenological findings may be very similar. It usually results from an otitis media and it is important to go into the history. Diagnostic aspiration may be necessary to make the diagnosis. Smears and cultures of the pus removed settle the diagnosis.

4 *Osteosarcoma* develops slowly and often gives a sensation of fluctuation, but the lesion is not so circumscribed or regular the surface is uneven and the tumor is soft in some places but firm in others there usually is a well developed collateral circulation, and while the swelling may show pulsations which are expansile and synchronous with the pulse compression of the carotids reduces the volume of the swelling. Local increase in temperature may be present, even 2 degrees in a rapidly growing sarcoma. When it ulcerates through the skin a mushroom-like neoplasm develops and this bleeds easily and readily becomes infected.

5 *Perforating malignant tumor*. This is most often a tumor of the dura mater and usually occurs in the parietal region. These are associated with symptoms of marked compression of the brain. After perforation of the skull has occurred and the growth lies beneath the soft parts the



Fig. 7. Roentgenogram of chest. Case 1, taken May 11, 1915, after the second operation, during which the eleventh right rib was resected, the carious portion of the rib together with the cold abscess lying over it being cut away as one would a malignant neoplasm. Note the moderate pneumothorax which resulted from puncture of the pleura. Note, also, the enlarged lymph gland (tuberculous) just above the heart shadow and just to the left of the spine, pushed to the left by the pneumothorax.

mass which is palpable is irregularly rounded and is usually firm.

6. *Cephalohematoma sebaceus*, *cyst lipoma*, *angioma*, *generalized actinoid fibrosis*, *cystic actinomycosis* are easily differentiated, and a roentgenogram will rule out tuberculosis.

7. *Actinomycosis* of the skull is rare and the primary focus is easily diagnosed.

8. *Hydatid cyst* is rare in the vault usually attacks the frontal bone and the osseous abscess may closely resemble a cold abscess. It is round, often compressible, and is painless. The diagnosis is often difficult, but aspiration and examination of the fluid removed clears up the diagnosis. A guinea pig inoculation should be made and the patient should be given a Weinberg test.

PROGNOSIS

The prognosis depends on the gravity of the associated tuberculosis lesions present, especially the pulmonary lesions, and on the extent of the disease in the skull. If the general condition of the patient is good and the cranial lesion is circumscribed, the outlook is very good. In the progressive infiltrating type the outlook is more grave and when the area of skull involved is

extensive, it may be impossible to remove surgically all the diseased tissues. Incomplete operation requires secondary operations and chronic fistulas and other sequelae usually result.

If the skull lesion appears late in the course of progressive general tuberculosis, the outcome is, of course, obvious. However cases in which multiple foci exist in other bones, or in other organs, often can be cured.

Cases of primary tuberculosis of the vault show the greatest percentage of cures. Of the 48 cases which were collected by Pelletier 43 were shown as cured.

Tuberculosis of the external table alone, is very benign. Villemin had 11 such cases, and in all a mere superficial curettement of the outer table resulted in the cure of all 11.

TREATMENT

The only proper treatment is radical surgical removal of all diseased tissue except for cases obviously hopeless, as my Case 3.

In the circumscribed type, the French (Lenormant, Joutard) advise a horseshoe shaped incision wide of the cold abscess, and carried right down to the bone. All soft parts, including the periosteum are now turned down so as to expose the diseased bone. If possible, the cold abscess is excised like a tumor. If a fistula exists, the diseased tissues are cut away by wide incisions, care being used to excise the borders. The French surgeons now curette out any friable bone. This is all that is required if the external table alone is involved. Otherwise when a perforation is present, they enlarge the opening by means of a bone-cutting forcep cutting away until healthy bone is encountered. Below one sees the tuberculous granulations on the dura. These ordinarily do not extend over an area of more than 1 or 2 centimeters. It is essential to reach healthy dura in every direction. There is little bleeding and after gently sponging off and being sure to have the surface dry the area that was covered with granulations, is painted with zinc chloride as is also the margin of the bone defect, dusted with iodoform powder and the flap of soft parts is stitched in place, without any drainage.

I prefer the German technique. I use a straight incision, and on reaching the periosteum, excise the perforation in the bone just as one would a malignant tumor cutting away a circular disc, at the center of which lies the perforation. After curetting off the granulations from the dura, I swab off the dura and bone edges with tincture of iodine dust iodoform powder on the dura and close without drainage.



Fig. 8. Photograph of Wm. D. Case 2, taken after the second operation before the stitches had been removed. Note that the scar from the first operation, excision of the perforating lesion in the left frontal bone, performed April 20, 1925, is scarcely visible, the black areas along the line of this skin incision are due to iodine stains. The line of incision made to remove the lesion in the parietal bone and the cold abscess overlying it can be made out plainly as the skin stitches are plainly visible. This operation was performed May 6 1925.

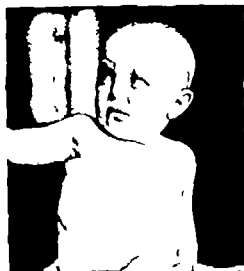


Fig. 9. Photograph of Wm. D. Case 1, taken a few days before his discharge from the hospital May 14, 1925. The two scars, frontal and temporal, are just barely visible. The scar from the resection of the eleventh rib is plainly seen, though completely healed. All three incisions healed *per primam*.

RESULTS

Primary union can usually be anticipated

In 76 operations Pelletier found 52 complete cures, 16 deaths and 8 incomplete cures that is with fistulas. Joutard, in 13 observations reports 9 operations, with 7 cures, 1 with a fistula. Adding my operations to those in the literature, we find that in 87 operations, there were 60 complete cures, 18 deaths, and 9 incomplete cures—that is with fistulas.

CASE REPORTS

CASE 1. Wm. H. D. male aged 2 years, entered the Michael Reese Hospital, on the private service of Dr. Isaac A. Abt, April 8 1925. The child had been perfectly well up to January 1925 when he pinched his right hand with a toy. He developed a large swelling on the hand which was not inflamed but tender and firm and remained as a localized swelling for about a month, when it became red and inflamed. It was looked by a physician and pus escaped. This tumescence had not yet healed. In February 1925, he hit his forehead with a shoe tree and later developed a swelling over the left frontal region which had slowly increased in size but at no time had it been inflamed or painful. On entrance to the hospital, the swelling was very hard. Later in February he struck the left side of his head on the corner of a table and following this a swelling developed in the left parietal region. In March the child hurt the right side of his chest by striking against a chair. Except for these local swellings the child seemed perfectly well and was well nourished. He had no cough or fever.

Physical examination revealed on the left side of the head just above the ear a moderately hard round swelling about 3 centimeters in diameter which was not tender, red, or fluctuant, and which seemed to be adherent to the underlying structures (Fig. 1). The skin was normal and freely movable over it. There was a similar but somewhat smaller swelling in the middle of the forehead at the hair line. On the right side of the chest, at the level of the eleventh rib there was another large swelling of similar character (Fig. 1). On the palm of the left hand was a small scar surrounded by a red area which marked the site of the incised lesion. The pharynx was somewhat injected and the tonsils were hypertrophied. The neck was negative except for a slight adenopathy in the anterior groups under the sternocleidomastoid on both sides. The lungs were normal. The impression of the interne who wrote this report was that it was a case of multiple hematomata, chloroma, multiple sarcomata. Dr. Abt's notes on April 9, the day of admission, confirmed the physical findings as already noted.

Urinalysis on the day of admission showed normal urine. The same was true on April 14, except for a trace of acetone. There was no Bence Jones protein. Blood examination on day of admission showed hemoglobin, 80 per cent red blood cells, 4,800,000 white blood cells, 32,800 differential count, polymorphonuclear leucocytes, 50 per cent, small lymphocytes, 36 per cent large mononuclears, 3 per cent, eosinophils, 1 per cent, monocytes, 10 per cent. The bleeding time was 3 minutes, clotting time, 7½ minutes.

A roentgenogram of the skull and one of the chest was taken the day of admission. The report read: The films of the skull reveal an area of erosion in the left medial frontoparietal area that appears to be simply a bone destruction without anything characteristic about which to determine its etiological factor. There is also a similar area of bone destruction at the end of the eleventh rib, right. At this point there is both extension and thinning of the cortex. This suggests malignancy.

On April 10, the swelling on the scalp was aspirated and about 2 centimeters of yellow purulent fluid was removed. A specimen, stained by the Wright method re-



Fig. 1. Photograph of Wm. M. Case 2, taken after discharge from the Michael Reese Hospital. Note his well nourished appearance. His skull had two circumscribed perforating lesions of the skull, frontal and parietal, and extensive tuberculous involvement of the right radius, right second metacarpal, right tibia, and left side of the mandible.



Fig. 2. Anteroposterior roentgenogram of skull, Wm. M. Case 2, showing circumscribed perforating tuberculous of left frontal bone.

called polymorphonuclear leucocytes and necrotic debris. Culture showed no growth in 48 hours.

On April 1 the swelling over the rib was aspirated and about 5 centimeters of material was obtained. Gram stain revealed nothing. Carbol fuchsin stain for tubercle bacilli revealed no organisms. Wright's stain and cresyl violet revealed nothing unusual. Cultures made were negative no growth. A second blood examination made April 1 showed white blood count 18,000 and the differential count, polymorphonuclear leucocytes, 60 per cent, small mononuclear lymphocytes, 30 per cent, large mononuclear lymphocytes, 1 per cent and myelocytes or myeloblasts, 8 per cent.

A diagnosis of probable circumscribed perforating tuberculous of the skull and tuberculous of the rib was made and it was suggested that a von Pirquet test be made. The test was made April 2 and proved positive in 24 hours.

Open operation on lesions of the skull completely curing out all tuberculous tissue to guard against tuberculous meningitis, was recommended. The lesion in the mid frontal area was attacked at the first operation, and later the lesion in the left parietal region and the diseased rib were excised at a second operation. The first operation was done April 20, 1935. An incision was made over the swelling in the left frontal region, the incision being directed parallel to the longitudinal suture and being carried down to the periosteum. Thus there was exposed a rounded, dome-shaped prominence, bluish in color, semisoft in consistency typical of subperiosteal abscess, over a circumscribed perforating tuberculous of the skull. Next, the periosteum was cut through, circularly well beyond the limits of the swelling; the cut edges retracted laterally so that the bone was exposed in a circle at a distance of perhaps 0.5 centimeter from the periphery of the subperiosteal abscess. Then with a Doyen bone drill, a small hole was

bored through the cranium at the posterior point of the circle and the dura was exposed. Now, with Lambard rongeur forceps, the hole through the skull was enlarged circularly entirely about the subperiosteal abscess. In the circle where the periosteum had been stripped back. Then, with a bone elevator a disc of bone containing the lesion at its center was gently lifted away from the dura. The dura had not been injured in the procedure. At the center of the exposed area of dura, a small amount of tuberculous granulation tissue still remained adherent to the outer surface of the dura. This tissue was gently curetted off as well as possible, care being used not to perforate the dura (danger of tuberculous meningitis) a very small bit of pathological tissue remained, however. This tissue was painted with tincture of iodine and then dusted with iodoform powder. After all bleeders which had been caught with forceps were carefully ligated, the soft parts were closed without drainage in two layers, plain catgut being used for the muscle and aponeurotic layer and silk for the skin.

It did not seem wise to attack the second cranial focus at this time. Healing occurred by primary union and there never was the slightest suggestion of inflammation locally or any drainage. The child continued to show a slight evening rise in temperature, just as occurred before operation, but except for this, seemed well. The report of the pathologist on the examination of the tissue removed at the first operation reads:

Pathological diagnosis tuberculous osteomyelitis with caseation. The specimen consists of three small bits of bone and soft tissue, quite discolored and dotted with small yellowish nodules and one larger plug of tissue covered on one surface by periosteum and beneath by a shell of bone between a whitish degenerated and soft tissue.

"In the section through the soft tissue there are seen numerous areas, in the centers of which are well marked



Fig. 12. Lateral roentgenogram of skull, Case 1, showing the circumscribed perforating lesion in the frontal bone and the circumscribed perforating lesion in the left parietal bone. Note also the tuberculous involvement of the left side of the mandible.

Langhans giant cells surrounded by epithelioid cell reaction and outer zone of lymphocytes. Some areas are necrotic and along the periphery of these areas may be seen remnants of tubercles with giant cells. The surface is hemorrhagic and blood vessels in it are markedly engorged with blood. Along the periphery of some of the necrotic areas there is considerable congestion of blood vessels. One bit of tissue is almost completely necrotic but still the remnants of granulomatous formation can be made out. There is one small bit of bone in this section which is embedded in the tuberculous process. Section through bone—the cellular outlines are impossible to make out because of the marked necrosis and changes in decalcification. The marrow seems more fibrous than normal, and the shadows of round cells can be indistinctly made out. Undoubtedly the condition is one of a tuberculous process involving the bone with involvement of the adjoining soft tissues."

A roentgenogram of the skull taken May 14, showed the operative defect (Fig. 5).

On May 6 the general condition of the child warranted going ahead with the second operation—excision of the perforating focus in the left parietal region of the skull and resection of the eleventh rib focus. A vertical incision about 6 centimeters long was made, with its center over the rounded swelling in the left parietal region of the skull, cutting down to the periosteum, above the swelling and down to the temporal fascia over the cold abscess. The temporal fascia and muscle were now dissected downward as follows: the temporal fascia was cut through in a semi-circular arc, the origin of the middle third of the temporal muscle being detached, and the temporal fascia and muscle together were turned and retracted downward. This exposed a circumscribed perforation of the skull which completely penetrated both tables. A cold abscess above the outer opening of this perforation penetrated the periosteum and extended into the temporal muscle a short distance. The area of bone defect was almost circular and measured about 1 centimeter in diameter. The area involved lay just below the linea temporalis inferior and was covered by the temporal muscle and fascia. The cold abscess, with typical caseous contents, extended backward and down

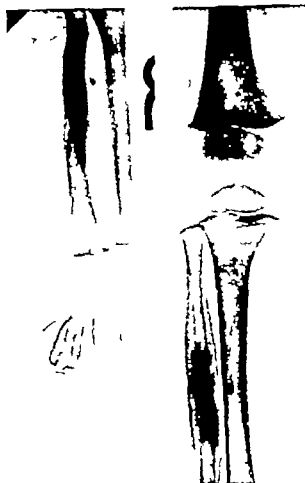


Fig. 13, left. Roentgenogram of right forearm and hand Case 1. Note the typical tuberculous dactylitis of the second metacarpal bone and the tuberculous involvement of the radius.

Fig. 14. Roentgenogram of left leg, Case 1. Note the tuberculous involvement of the fibula.

ward over a considerably larger area than the area of skull bone eroded, penetrated the temporal muscle and bulged this upward. All this involved temporal muscle was removed by cutting away the diseased tissue. Next, by means of a Lumbar bone rongeur the margins of the perforation were cut away until normal bone was reached. The resulting bone defect was about the size of a nickel and exposed the dura well beyond the area covered with tuberculous granulations. The tuberculous granulations on the dura were now gently curetted off and then the surface of the dura was swabbed with tincture of iodine, dried and dusted with iodoform powder. The reflected temporal muscle and temporal fascia were now stitched back into place interrupted stitches of No. 1 chromic catgut being used. The fascia of the occipitofrontalis muscle was sutured with a continuous plain catgut suture, and the skin accurately closed with interrupted sutures of black waxed silk.

Next the involved rib on the right side of the chest was palpated (the cold abscess was plainly palpable) and an incision was made through the skin over this rib, the incision being carried 1 inch beyond the swelling both anteriorly and posteriorly. After the incision was carried with care down to the cold abscess, but not into it, the entire diseased area was excised as one would a malignant tumor i. e. the latissimus dorsi and intercostal muscles



Fig. 5. Roentgenogram of the skull, Case 3, taken June 9, 1931. Not the typical circumscribed perforating tuberculous of the right parietal bone. The perforation is so clean cut that the roentgenologist reported "There appears to be an operative defect in the right parietal bone. The dark shadows radiating about this defect, and well beyond its borders, are due to tuberculous granulations on the surface of the dura, external tuberculous pachymeningitis over the right parietal bone."

were cut well wide of it, above and below, and then the rib was divided subperiosteally by means of a Schoemaker costotome first 1 inch anterior to and then 1 inch posterior to the swelling. This portion of the rib together with the overlying cold abscess was now resected as one mass. Although great care was taken not to penetrate the parietal pleura lying behind this mass, the pleura was perforated in two small places. One of these openings was of but pin point size; the other only a little larger. Both openings were at once covered with dry gauze and then closed by means of a catgut suture. The entire defect was swabbed with tincture of iodine dusted with iodoform powder and closed without drainage, the muscles being sutured together with catgut and the skin closed with running black waxed silk suture. The child stood this double operation well and left the table in good condition.

Pathology. The skull lesion was typical circumscribed perforating tuberculous of the vault of the cranium.

The rib lesion likewise, was typical of tuberculous. The cold abscess contained about a drum of typical caseous tuberculous material, was thick walled and was in intimate relation to the eroded area of the rib seen in the roentgenogram (Fig. 4).

Following this second operative attack which consisted of two operations, the one on the skull and the rib resection, the postoperative course was essentially uneventful.

Except for a slight amount of transient edema about the left eye which lasted only a few days, convalescence was uneventful. A roentgenogram of the chest, taken May 5 days after operation, showed slight pneumothorax on the right side but no evidence of fluid (Fig. 7). Both the skull wound and the chest wound healed by primary union. The pathologist's report reads: "There are two pieces of tissue marked *rib*. The smaller piece measures 2.5 by 2 by 0.4 centimeters. The surface is irregular and covered partially with fat. The section consists chiefly of firm white tissue which is mottled with small yellowish areas about pin head size. The larger piece measures 3.5 by 3 by 2 centimeters. One surface consists of bone. To the other surface is attached a mass of tissues

which on section shows a large irregular yellowish necrotic area."

A piece of tissue marked *skull* is irregular and measures 1.5 by 1.3 by 0.8 centimeters. When cut it showed yellowish flecks in a glistening fibrous tissue.

Various sections through the soft tissue show a marked tuberculous reaction which is quite proliferative in places and in the center of some of the tubercles there is caseation. The tubercles very often contain well formed Langhans giant cells. The surrounding muscular tissue is infiltrated with lymphocytes, and there is some proliferation of the fibrous tissue. The muscle itself shows no tuberculous involvement but the area about the muscle is completely involved. The bone spicules do not seem to be necrotic, on the other hand they are fairly well preserved. The intervening medullary tissue of the bone is quite active, the forms being usually of the polymorphonuclear type. In some places it is slightly fibrous but there is no definite tuberculous involvement of the bone itself. Outside the bone, however, in the periosteum and in the adjacent soft tissues, there is a marked tuberculous reaction with caseation and giant cell formation. From the section one would judge that the process had started rather in the periosteum or in the soft tissues than in the bone itself.

May 14, the child was discharged from the hospital with all wounds closed and healed. Roentgenograms taken before discharge show the two defects (Figs. 5 and 6). The child's general condition was improved and continued to improve and there has never been any recurrence of any of the three local lesions. When seen 3 years later the boy was entirely well, had grown normally and was healthy child.

CASE 2. Wm. M., a white boy aged 5 months, entered the pediatric service of Michael Reese Hospital, April 22, 1930. The child had always looked pale, but for the last 3 or 4 months the mother had noticed that he was not active physically and was content to sit still instead of walking. Mentally he seemed bright enough though he seemed to sleep a good deal.

In January 1930, about 3 months before entering the hospital, the mother noticed a small swelling on the right frontal region, which had gradually become larger until, at the time of entrance, it was about the size of a nut. It had always been quite hard. There had never been any discoloration of the skin over it, no pain, and no tenderness on pressure. About 2 weeks before entrance, the mother noticed that a small swelling had appeared on the dorsum of the right hand and that since that time it had enlarged to the size of walnut. It was round, quite hard, freely movable, not painful or tender and the skin over it was not discolored.

The past history was essentially negative. The child was a full term, normal delivery infant, breast fed for 3 months, then fed on pasteurized milk. There was no history of acute infections, of cough or frequent colic. He had gained weight normally. There were no enlarged glands in the neck or groins and no history of tuberculosis in the family.

Physical examination on the day of admission, elicited a well developed and well nourished boy of 4 months of age, though he appeared anemic (Fig. 10). There were two prominences over the left frontal bone, one bony hard, the other softer; both about walnut size, not movable, not tender. The skin over them was normal and freely movable. There was a similar bony prominence of the posterior portion of the left side of the mandible. The tonsils were rather large and slightly injected. There was some anterior and posterior cervical adenopathy on both sides of the neck. The lungs were normal. There was bony prominence of the proximal half of the second right meta-

carpal and also local tenderness over this swollen portion of the bone.

On May 23 urinalysis was done and Bence Jones protein looked for and reported absent. A von Pirquet test was done and this was reported negative. A blood examination made the same day showed hemoglobin 50 per cent red blood count, 5,030,000. Differential count showed polymorphonuclear leucocytes, 23 per cent small lymphocytes, 70 per cent, large lymphocytes, 2 per cent eosinophils, 1 per cent and myelocytes, 3 per cent. In the morning the temperature was normal as a rule but in the afternoon usually rose to 100 degrees. All temperature readings were done per rectum.

On May 24, roentgenograms were taken of the right and left forearms and hand and of the left mandible. Films of the osteal system disclosed a spindle shaped swelling of the middle of the left fibula (Fig. 14) the right ulna, the second metacarpal, right (Fig. 13) and a bony swelling of the left inferior mandible (Fig. 12). The roentgenologist's report was: "The periosteal lamination over the involved portion of the left fibula and the second metacarpal resembles lines. However the appearance as a whole is that of multiple myeloma. Blood chemistry done this day showed calcium, 10.3 phosphorus, 4.5.

Due to the fact that measles developed in the ward the child was sent home on May 2, 1930, with diagnosis not determined. Before sending him home, the swelling over the right side of the head was aspirated and clear fluid removed. Stained smears showed no cells.

The child was admitted again May 20, 1930. Examination at this time showed no change in the size of any of the swellings. On June 6 X-ray treatments were given to the head and hand. The child continued to show days of normal temperature and again days with a rise to 100 degrees. On July 11 he developed measles and was discharged from the hospital on July 12 with the diagnosis "multiple myeloma." He was again admitted, and it was found that the swelling of the hand over the right second metacarpal bone had increased in size. I was asked to see the case and diagnosed tuberculosis of all bones involved. A von Pirquet test was now made and was strongly positive within twenty four hours. The swelling was aspirated and smears, cultures, and a guinea pig inoculation were made. The guinea pig test was positive for tuberculosis and thus my diagnosis was substantiated. The child was then discharged to the Chicago Tuberculosis Sanitarium.

CASE 3. This case was one in which the diagnosis of tuberculosis was obvious. The patient, W. B., a negro boy, 13 years of age, had spent 4 of the last 5 years in the Cook County Hospital. He was originally admitted in 1928 because of a congenital heart lesion, but later was sent to the Municipal Sanitarium because of draining tuberculous cervical glands. He remained there a full year.

He was re-admitted to the Children's ward in March, 1930 because of abdominal pain associated with fever and a tender mass in the abdomen the size of an orange. Examination at this time showed an essentially healthy looking boy of about 11 years. Temperature was 102.8 degrees, pulse 88, respirations 24. The scalp was negative. No pathological findings were noted anywhere else on the head except small ulcerations on the right side of the nasal septum and a few in the right vestibule of the nose. The throat was not injected and the tonsils were not enlarged. Examination of the neck showed several scars and a draining sinus on the left side. There were several similar scars on the left side of the chest and on the left axilla. Examination of the glandular system revealed discreet, firm, painless glands in the neck, in both left and right anterior cervical chains, more numerous on the left side

left suprascapular region and left axilla. No epitrochlear or intercostal glands were noted, there was a moderate lingual adenitis. Lung examination was essentially negative. The roentgenogram taken the day after admission, was reported healthy chest. Heart examination showed slight enlargement. It presented a mitral configuration due to a prominence and enlargement of the pulmonary curve. There was a systolic diastolic murmur heard best over the third intercostal space and transmitted in the carotid. The abdomen was distended and tender in both upper quadrants and a doughy mass, the size of an orange, was felt in the lower abdomen. No other physical findings of interest were noted. A diagnosis of tuberculous peritonitis with retroperitoneal glands was made. A Mantoux test on the left arm was strongly positive as was, later also a von Pirquet. The blood count was 24,000 with an eosinophilic count of from 5 to 10 per cent on different examinations. The mass in the abdomen gradually decreased in size and the child's temperature gradually returned to normal. On April 23 a lymph gland was removed from the left axilla for biopsy and this showed the typical findings of a tuberculous lymph gland containing creamy caseated material. The wound healed rapidly and the boy was discharged from the hospital on April 27, 1930. At that time he seemed in very good condition.

He was not seen again until August 23, 1930 when he was readmitted because of a painful mass in his abdomen. He was not acutely ill. Temperature was 100.4 degrees, pulse 96, and respirations 32. Examination of head showed no findings of interest except "recovering boil." This is the first and only indication in the record pointing to any skull involvement. It is unfortunate that roentgenograms of the skull were not made at this time. The glandular swellings noted during the previous stay in the hospital showed some increase. There was a large mass of enlarged glands on the right side of the neck, scars from the draining fistulas on the left side and a cold abscess over the left lower chest, posteriorly. Lung examination now showed evidence of tuberculous involvement of the left upper lobe and the right lower lobe. The heart showed enlargement to the left, the left border being outside the nipple line. A systolic murmur audible over the entire precordium was transmitted to the axilla and the second pulmonary was accentuated. No masses were palpable in the abdomen. The impression was glandular tuberculosis with pulmonary involvement. A roentgenogram taken August 25, 1930, showed hilus shadows suggestive of right hilus tuberculosis. He continued to run a low grade temperature and later had afebrile days. The lumbar cold abscess was aspirated on November 7, 1930, but continued to drain for weeks. In December, the right cervical glands enlarged and became tender and later broke down. This new cold abscess was aspirated. In January an abscess formed over the right shoulder and later ruptured spontaneously. Later in January he developed pain in the left ankle and left elbow. In February multiple scalp abscesses developed, accompanied by a septic temperature. A note on March 18 states that the head was discharging and temperature was still septic. The temperature later gradually fell but again became subfebrile. During the next month he gradually improved until by the end of April he was discharged from the hospital though he still ran an afternoon rise of temperature.

He was not seen in the hospital again until June 8, 1931. This time he was brought in because of his heart. He still had open lesions over his body. Temperature 101.8 degrees, pulse, 114 respirations, 22.

The finding of outstanding interest on this admission (so far as this report is concerned) was a large area of inflammatory reaction and crusts over the left frontal

parietal area of the skull. This area showed pulsations synchronous with the pulse. Without going into detail of the other physical findings, it suffices to state that there was progression of the tuberculosis generally and of the cardiac pathology. A roentgenogram of the skull, taken on June 9 (Fig. 5) showed circumscribed defect in the right parietal bone typical of circumscribed perforating tuberculosis of the vault. It is interesting to note that the roentgenologist's report reads: "There appears to be an operative defect in the right parietal bone. Except for headaches there were no cerebral or meningeal symptoms. The child condition went from bad to worse. He developed military tuberculosis and died on July 30 from cardiac failure."

Autopsy was performed. The pathologist's report reads: "Miliary tuberculosis of the lungs, spleen, liver, kidneys

and thyroid. Caseous tuberculosis of the peri-pancreatic, mesenteric, mesocolic, and superior mesothelial lymph nodes. Perforation of tuberculous mesocolic lymph nodes into the sigmoid colon. Tuberculous caries of the right parietal bone with perforation and sinus formation. Tuberculous caries of the bodies of the seventh, eighth, and ninth dorsal vertebrae, of both tubera calcanei and the right elbow. External tuberculous pachymeningitis over the right parietal lobe. Solitary tubercles in both cerebellar hemispheres. Tuberculous ulcers in the lower ileum. Traction diverticulum of the esophagus. Obliteration of the pericardial sac. Fibrous adhesions about both lungs. Ascites."

NOTE.—For complete literature to date see abstract of article as reported in the *Transactions of the Western Surgical Association*, 1931.

CONGENITAL HYPERTROPHIC PYLORIC STENOSIS

TREATMENT OF ACCIDENTAL PERFORATION OF MUCOSA DURING RAMMSTEDT OPERATION

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HYPERTROPHIC pyloric stenosis in infants is considered by most authorities to be of congenital origin, as it has been found in infants of the later prenatal months. Cautley has reported this condition in a 7 month fetus, but there are others who claim that hypertrophic pyloric stenosis is due to recurrent spasm of the circular muscle fibers of the pyloric ring and canal. To me it seems rather incredible that there could develop such marked hyperplasia as a result of spasm, especially since we find this disease in very young infants and even before birth.

Singularly pyloric hypertrophy is about seven times as common in male children as in females. It occurs in about one male child in every two hundred births and usually in breast fed children. No evidence of racial predisposition has been demonstrated. It has been reported two or three times in one family.

The clinical picture is uniform but striking. The characteristic vomiting is forcible and projectile and generally occurs soon after nursing even while the child is still at the breast. The vomitus is large and free from bile. Usually the stomach is completely emptied. The gastric peristaltic waves can be readily seen and often the tumor palpated, especially if the child is already emaciated.

Medical treatment for this disease has been advocated. But it seems to me that when the hypertrophic condition is well developed and a tumor can be felt, surgery alone can give lasting

relief. Medical treatment only increases the dangers of an unavoidable operation due to the weakened condition of the infant. There are undoubtedly cases of spasm of the pylorus due to temporary causes—such as improper feeding—which give symptoms similar to that of hypertrophic pyloric stenosis. These cases naturally respond to medical treatment.

Surgical treatment of pyloric stenosis in infants was first attempted in 1898. Its evolution to the present time has been quite remarkable. The original surgical procedure was about the same as used on an adult for pyloric stenosis. Some operations, suggested and tried in the treatment of this disease have been pylorotomy, plastic operation of the Mikulicz type—that is cutting the muscles longitudinally and attempting to suture them transversely and forcible dilatation after gastrotomy—by inserting the finger in the pylorus, also posterior gastro-enterostomy. The last mentioned is undoubtedly the most successful. However the mortality is high in such extensive operations when performed on an infant already enormously weakened by its inability to retain food.

Aware of this tragic fact, Rammstedt in 1913 demonstrated a simpler operation. It consisted in incising longitudinally through the serosa and thickened muscles, dividing them down to the mucosa. The simplicity of this operation for the treatment of this disease and the splendid results obtained has made it practically universally adopted.

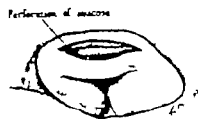


Fig. 1

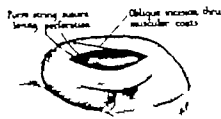


Fig. 2



Fig. 3



Fig. 4. Perforation in midportion of mucosa.



Fig. 5. Suggested repair of perforation in midportion of mucosa.

The Ramstedt operation accomplishes its purpose. But there is a certain amount of danger of accidental perforation of the mucosa that may occur in spite of every possible precaution. This accident, if not discovered at once and taken care of immediately will invariably prove fatal to the patient.

Recently I had this misfortune. The perforation occurred at the distal end of the incision in the duodenum—the most frequent place for a perforation to occur (Fig. 1). I used a purse string suture to close the opening. Then it occurred to me that this could be reinforced. I made an oblique incision and secured a triangular flap as shown in Figure 2 which I sutured to the thickened muscular coats over the site of the perforation (Fig. 3). This procedure made a very satisfactory repair of the perforation and I felt assured that the patient's recovery would not be thereby handicapped. In certain cases this suture line may also be protected by the use of omentum. In

the above mentioned case this added protection did not seem necessary.

This same type of repair could be also applied to the proximal end of the incision. However when the perforation is in the midportion of the mucosa, it would not be practical. An accidental perforation at this point is quite unusual but in case it does happen as in Figure 4, it may be advisable to make a longitudinal incision about one-quarter of an inch to either side of the primary incision and the intervening flap sutured to the muscular coats over the site of the perforation as in Figure 5.

While it is quite possible to repair these perforations when they occur by means of suturing them and then transplanting a piece of omentum over the perforation this type of repair I am sure, is not as efficient as the one described which has the additional advantage that it can be done quickly without subjecting the infant patient to added risk.

FRACTURES OF THE TUBER CALCANEI INVOLVING THE MEDIAL AND LATERAL PROCESSES

A DISTINCT TYPE OF FRACTURE WITH A SUGGESTED METHOD OF TREATMENT

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THE calcaneus is the largest and strongest of the tarsal bones and forms the heel of the foot. It comprises the posterior base of the longitudinal arch of the foot which extends from the heel to the heads of the metatarsal bones and forms the posterior weight bearing portion of the arch. The lower posterior and posterior inferior surface of the calcaneus is called the tuber calcanei. The tuber calcanei is composed of a medial and lateral process projecting anterior from the under surface of the tuber and the body of the tuber calcanei proper. The medial and lateral processes have no distinct line of demarcation where they join the body of the tuber but the ridge formed by the medial and lateral processes is continued well back into the body of the tuber calcanei. It manifests itself by a flaring or widening of the under surface of the heel, and it is this region and the under surface of the medial and lateral processes of the tuber calcanei that forms the immediate weight bearing portion of the calcaneus.

During the past few years much has appeared in the surgical literature regarding fractures of the calcaneus. The greater number of these writings describe various methods and appliances used in the reduction and treatment of the various types of fracture of this bone.

The thing that impresses one when making a survey of this literature is that the trend in treatment of these fractures has for its object a close approximation of the fragments with some method of maintaining that approximation. By returning this fractured bone to approximately its normal anatomical condition, the prolonged periods of healing and disability and the marked deformities which have been so prevalent in these fractures are lessened.

While fractures of the calcaneus are still looked upon as one of the most hazardous type as regards future impairment, still present day methods of treatment give the situation a much different aspect.

The older methods of treatment, in which the fractured foot was placed in a plaster cast with very little attempt to reduce the fragments of the fractured bone are very much in contrast to the present day methods of dealing with this injury.

Naturally the former treatment gave very poor results, prolonged the period of disability and left many cases with varying degrees of abnormality.

Statistics from various sources at the present time show that fractures of the calcaneus form approximately 2 per cent of all fractures. By far the greater number of these occur in men, and the average age at which they are produced is around 40 years, which age is the most active and remunerative part of the individual's life. The various periods of disability in these cases extends from a few months to a couple of years, and when it is considered that practically all of these cases occur in men during the compensative period of their lives and that 2 per cent of all fractures are of this type the situation then becomes not only a surgical problem but represents a financial problem of some magnitude to the patient as well.

Fractures of the calcaneus are usually classified according to the region in which the fracture occurs and according to the manner in which the fracture is produced. Therefore, the type of injury usually predetermines the type of fracture and if one knows the type of fracture, he can almost always state in what manner it was produced.

While the classification of fractures of the calcaneus varies somewhat among different authors, there is nevertheless a great similarity among them and I have chosen the one given by Speed in his text on fractures as being typical of most of them. It is as follows: (1) avulsion fractures, (2) isolated fractures of the sustentaculum tali, (3) isolated fractures of the trochlear process, (4) compression fractures of the whole bone.

Avulsion fractures are a rare type in which part of the upper posterior portion of the calcaneus is torn away by sudden contraction of the posterior muscles of the lower leg. The power of this muscular contraction is exerted through the tendo calcaneus (Achilles tendon).

Fractures of the sustentaculum tali are rare and are caused by extensive inversion of the foot. The sustentaculum tali is a bony protrusion on the medial side of the upper portion of the calcaneus and forms with its upper surface part of the articulation (facies articularis medialis) of the calcaneus with the talus. On the under surface of the sus-



Fig. 1. Fracture of the tuber calcanei involving the anterior process.



Fig. 2. Approximation with ordinary reduction.

tentaculum tali is a groove for the tendon of the flexor longus hallucis muscle.

The trochlear process is a small protrusion in the center of the lateral side of the calcaneus. Beneath this process runs a groove for the tendon of the long peroneal muscle. Fractures of the

trochlear process are also very rare and are due to a direct blow to the lateral side of the foot.

Compression fractures of the calcaneus are the most common type and comprise about 90 per cent of all the fractures of this bone. These fractures are most common in men. Compression fractures are caused by the individual falling from various heights and the condition derives its name from the fact that in the fall, which is direct upon the foot, the calcaneus is literally compressed under the weight of the body.



Fig. 3. Approximation by incorporating soft rubber ball in the cast in order to maintain constant pressure on the heel.



Fig. 4, left. End result with practically no secondary callus formation.

Fig. 5. Normal opposite heel for comparative purposes.



Fig. 6. Fracture of the tuber calcanei involving the medial process.

In the foregoing classification it will be noticed that each fracture described is a grossly distinct type and that each has a distinct manner in which it is produced.

Therefore to the above classification of fractures of the calcaneus I would add one more type, namely fractures of the medial and lateral processes of the tuber calcanei. These fractures are a distinct type taking place in a definite region of



Fig. 7. Approximation with pressure from soft rubber ball in cast.

the calcaneus and they are produced in a distinct manner. Though practically nothing is to be found in the literature regarding fractures of this nature I would venture that they are nearly as common as the compression type and have un-



Fig. 8. End-result with practically no secondary callus formation.



Fig. 9. Normal opposite heel shown for comparative purposes.

doubtedly been included under the latter heading. Fractures of the tuber calcanei are produced by the tubercular process of the heel being forcibly squeezed laterally by some sudden blow which acts the same as if the heel were put into a vise. This lateral pressure shears off parts of the lower portion of the tuber calcanei, which include either the medial or lateral process or both the line of fracture taking place along the old epiphyseal line which separates the tuber calcanei from the body of the calcaneus in early life.

EMBRYOLOGY

The calcaneus has two centers of ossification, a primary and a secondary, and follows the general rule that where a bone has a secondary center of ossification the primary center appears early. In the case of the calcaneus the primary nucleus appears during the sixth month of fetal life and is the center of ossification for the body of the bone.

The secondary nucleus appears from the seventh to the tenth year and forms the posterior or tubercular portion of the calcaneus. This epiphysis for the posterior portion of the calcaneus may include the entire posterior end or only the lower two-thirds of the tuber calcanei. If the latter condition prevails, the upper part of the tuberosity is ossified from the primary nucleus. The rest of the tuberosity, which also includes the medial and lateral processes, is formed from the secondary nucleus. The tubercular epiphyseal portion unites with the main body of the calcaneus during the thirteenth to the twentieth year of life, the average being about the sixteenth year.

ANATOMY

The calcaneus anatomically forms part of the longitudinal arch of the foot, the articulation with the cuboid forming the connection with the rest of the arch. Of the six surfaces of this bone the tuber calcanei forms the posterior portion of the inferior and the entire portion of the posterior surface the former including the medial and lateral processes. Of these two processes the medial extends the farther forward and is usually much wider than the lateral.

Three muscles have part of their origin from the anterior surface of the medial process of the tuber calcanei. They are the flexor digitorum brevis, abductor hallucis, and the abductor digiti quinti. Ordinarily, the body of the abductor digiti quinti originates on the medial process of the tuber calcanei but in some rare instances it originates entirely from the lateral process of the tuber calcanei. Besides these three muscles, the long plantar ligament has for its posterior attachment the

under surface of the tuber calcanei. The posterior surface of the tuber calcanei is composed of a smooth upper portion a more or less rough medial portion and a similar lower portion. The upper portion is smooth and separated from the tendo calcanei by a bursa. The middle portion forms the region for the attachment of the fibers of the tendo calcaneus and the fibers of the plantaris muscle. The lower part of the posterior region forms a smooth rounded surface over which lies the fatty portion of the heel. The muscles which have their origin on the medial and lateral process of the tuber calcanei have the following function. The flexor digitorum brevis draws the second phalanx of the second third fourth, and fifth toe plantarward. The abductor hallucis draws the large toe lateral and plantarward. The abductor digiti quinti draws the first phalanx of the small toe lateral and plantarward.

In the act of walking there is a co-ordination of action between the foot and the toes. The weight of the body first comes on the heel and is then transferred to the longitudinal and anterior arch of the foot and then to the toes. This co-ordinated action is the element that makes walking a smooth, unobstructed, firm action and is markedly different from the awkward cumbersome and inconvenient act seen in individuals with deformed feet or artificial limbs. It will thus be seen that the flexor digitorum brevis abductor hallucis and abductor digiti quinti are muscles which by their origin on the medial and lateral process of the tuber calcanei and their insertion on the under surface of the toes, have an important function to perform in the act of walking. It is, therefore, true that the medial and lateral processes have distinct muscular attachments and in fractures of these processes the tendency is for the muscles mentioned to draw the fractured fragment anterior and downward and to act against complete approximation of the bones.

While these fractures are not as serious as the more severe compression type nevertheless due to the fact that they take place on the immediate weight bearing surface of the heel, they form a source of impairment which naturally is in proportion to the results obtained and the period of disability may extend into months.

The extent of this impairment is dependent upon the amount of secondary callus formation and the effect upon the muscles described as entering into the function of walking. This in turn is naturally dependent upon the approximation of the fragments. This type of fracture does not necessitate an operative procedure to place the fragments in position, but it does demand that

the fragments be completely approximated and held firmly in that position, thereby lessening the secondary callus formation and preventing a heel with marked exostoses.

Bone irregularities on the under surface of the calcaneus form a very painful type of disability and naturally the closer they are to the weight bearing portion of this bone the more painful they become.

Exostoses are prone to appear on the under surface of the tuber calcanei, due to the great pressure and secondary irritation of the callus when the patient begins to walk about and put his weight upon the injured heel. Irritation is the most common cause of exostoses and it is more apt to occur in this region because this portion of the anatomy is especially subject to great pressure.

Secondary irritation in this region is often the causative factor of small spurs of bone running forward from the under surface of the tuber calcanei. They extend out into the muscle and fascia of the plantar region. These spurs, if later injured, sometimes form an acquired or adventitious type of bursa which causes pain when weight is placed on the foot.

Other conditions which are not in the form of exostoses, such as osteitis and periostitis, may also form in this region following fractures and become very disabling.

In the healing of fractures there is formed between the fractured ends of the bones a temporary or what is also called a provisional callus. This callus, which is originally gelatinous, becomes cartilaginous and later small centers of ossification appear in this region, and the tissue then becomes a definite bony callus.

The amount of this temporary callus formation is dependent upon the approximation of the fractured fragments. If the fragments are closely approximated there is very little provisional callus formed, but if the approximation is poor there is an excessive amount. This type of callus formation is also termed ensheathing callus. There is a certain amount of shrinking and absorption of the callus as healing and ossification take place but a considerable amount of this callus remains, especially if the original fragments have not been closely approximated.

It is the secondary callus which originates from the temporary or provisional callus that is one of the causes of lack of motion in fractures involving joints, and it is this same type of callus which causes irregularities in bone that results in pain and disability in fractures of the calcaneus, especially where the irregularities are present on the weight bearing portions of the foot.

When fractures are closely approximated, very little secondary callus remains. Under these conditions there is very little displacement and the fragments are returned closely to their normal anatomical position. Healing then takes place in a more direct manner. Small islands of bone proliferate from the compact bone of the fragments and by this action there is formed direct bony union. This latter type, called definitive or permanent callus, is a direct bony union from the beginning and does not go through the various stages of ossification as does a temporary callus.

The tendency then in fractures of the tuberosities of the calcaneus which involve the medial and lateral processes should be toward obtaining an absolute approximation of the fragments. This can be accomplished very nicely by applying some form of constant pressure to the region of the fracture. Thus I have been able to do by incorporating a soft rubber ball directly into the cast. The ball should be of a soft rubber type and should be large enough so that when indented it will mold itself to the region of the heel where it is desired that pressure be brought to bear. The ball should be allowed to press directly on the heel, no sheet wadding or stockinette being superimposed between the ball and the heel. The cast is then formed over and around the ball and should be applied firmly in order that one may bring pressure on the ball, which pressure then is transferred to the heel. The direction of this pressure should be such as will best maintain the fragments. Pressure applied in this manner has no effect whatsoever on the tissues covering the heel.

In the cases described, the cast is allowed to remain on the foot and lower limb for 3 weeks when it is removed and light therapy and massage instituted. At the end of the fifth week, the patient is allowed to bear some of his weight on the heel and by the end of the eighth week should be walking around in a normal manner.

CONCLUSIONS

1. Fractures of the tuber calcanei involving the medial and lateral processes are a distinct type, produced in a distinct manner and should be included in the classification of fractures of the calcaneus as such.

2. Excessive callus formation is responsible for prolonged disabilities resulting from this type of fracture and can be prevented by absolute approximation of the fragments.

3. Due to the fact that muscles of the plantar region of the foot tend to hold the fragments out of complete approximation they are best maintained by some form of constant pressure. This

pressure is best applied by incorporating a soft rubber ball in the cast in the region of the fracture

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CORRESPONDENCE

HYPERTROPHIC INTESTINAL TUBERCULOSIS

To the Editor I wish to draw your attention to an error in a paper Hypertrophic Intestinal Tuberculosis by Dr. A. A. Davis which appeared in the May issue of SURGERY GYNECOLOGY AND OBSTETRICS page 912. The author quotes statistics presented by Warwick,¹ where the error originally appeared. Scott² published statistics on tuberculosis of the appendix which included an analysis of 1250 appendectomies performed in the Montreal General Hospital. In these there were three instances of tuberculosis of the appendix. Warwick erroneously presented these 3 cases as 1.6 per cent instead of 0.16 per cent. Calculating the number of cases on the basis of 1.6 per cent, Davis concluded that there were 20 cases of tuberculous appendicitis instead of three in that series. Correction of this error will result in a reduction of the total number which he reports. I have noted several other statistical errors in Warwick's paper and have corrected these discrepancies in a report on this subject which is now in press.

LOUIS P. KARMAN

Brooklyn New York

Ann. Surg. 1930, Nov., 130.

Ann. Surg. 917 Nov., 445.

DEMONSTRATION OF MALIGNANT TUMORS

To the Editor During the week of September 17 to 24 Dr. Joseph C. Bloodgood and his associates will hold another of their demonstrations on tumors of bone and of the oral cavity. This year the demonstration will be held at the Mayflower Hotel in Washington where attractive rates and cooled rooms will be available. On Sunday evening September 1,

there will be a conference on the problem of preoperative and postoperative irradiation. On Monday a lantern slide demonstration of photomicrographs will be held and each one present will be given an opportunity to record his diagnosis. Tuesday, Wednesday, and Thursday will be devoted to bone tumors, and Friday and Saturday to tumors of the oral cavity. Dr. Bloodgood is anxious to attract to this demonstration as large a number as possible of pathologists, radiologists, surgeons, dentists, and physicians interested in the diagnosis and treatment of cancer in all stages and the local conditions that precede cancer. Those who plan to attend these conferences are requested to communicate with Dr. Bloodgood and the hotel manager and to present cases by means of lantern slides.

These demonstrations have a high educational value and offer an opportunity for the review of a massive collection of material and the exchange of opinions. Recognition of the early stages of the different forms of cancer and a widely disseminated knowledge of effective methods of their treatment is a *sine qua non* for progress in the campaign against cancer and such demonstrations further these ends. The American College of Surgeons for a long time has been receiving records of cases of bone tumors and other forms of cancer and has abundant evidence of the necessity for such instruction. Especially are these conferences commended to those who are on the staffs of the cancer clinics which are being so widely organized under the guidance of the College for it is to these that the greatest opportunity will be offered of seeing large numbers of such cases, and on them will rest the greatest responsibility for their recognition and treatment.

BOWMAN C. CROWELL

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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SEPTEMBER, 1933

CANCER OF THE COLON AND RECTUM

CARCINOMATA arising in the large bowel have a relatively low degree of malignancy. Most such cancers occur in the distal colon and a striking majority of them are found in the sigmoid and rectum. 69 per cent in our series. This section of the large intestine is less rich in lymphatics than the proximal colon and lends itself well to complete surgical removal. Carcinomata of the sigmoid are often of the annular constricting type, are slow in growth and produce reasonably early evidence of their presence. Carcinomata of the rectum are frequently degenerated adenomata. The adenoma of low malignancy can be diagnosed early and easily if attention be paid to the often trivial but definite symptoms which it presents.

The five year end results following radical surgery for cancer of the colon and rectum are surprisingly encouraging. We reported at the meeting of the American College of Surgeons in October 1932 that 34 per cent of our patients subjected to radical surgical

procedures to remove cancers of the colon and rectum are alive and well 5 years after operation. Other clinics have reported even better results.

If we divide the malignant lesions of the large bowel into two groups, one affecting the proximal colon and the other the distal colon, there are noted in each group certain distinctive features which are doubtless attributable to the functions of the affected segments.

Much of the time the proximal colon contains liquid faeces, thus the growth of organisms of high virulence is encouraged. Also fluid absorption takes place in this segment of the colon. Because this segment of the bowel carries the liquid faeces, few symptoms of an obstructive character are found here, but because of the fluid absorption the rich lymphatic supply and the amount of toxins present in this segment of the colon high degrees of secondary anemia are often associated with cancerous lesions here. For this reason all patients suffering from an unexplained secondary anemia should be carefully studied for the possible presence of an undiagnosed carcinoma of the proximal colon.

These same features, the presence of liquid faeces and of organisms of high virulence, add greatly to the risks involved in operation upon this portion of the colon because there is always the danger of peritoneal contamination. To overcome this danger we have utilized a method, which was described in this journal¹ of excising the right colon by a Mikulicz plan of approximating the remain-

¹Lahry, Frank H. Resection of the right colon and anastomosis of the stump to the transverse colon after the plan of Mikulicz. *Ann. Gynec. & Obst.* 22: 479, 1933.

ing ileum to the remaining transverse colon. This procedure has practically eliminated the danger of peritonitis.

Because of the solid character of the contents of the distal segment of the colon, the symptoms associated with carcinoma of this segment, especially of the lower portion, resemble closely those of mechanical obstruction. In the early stages of the carcinoma, secondary anaemia may be absent because of the fact that this the distal portion of the colon is by nature a storage segment and the faeces contained in it are solid, the fluids already having been extracted from them in the proximal colon. Thus media favorable for the propagation of organisms are lacking. Moreover the scarcity of lymphatics at this level of the colon helps to prevent the development of anaemia.

It is desirable to realize that the textbook feature—alternating diarrhoea and constipation—is too rarely absent and too often an evidence of a late lesion to make its presence of dependable value in the diagnosis of these lesions. In a series of one hundred consecutive cases of carcinoma of the colon in our clinic studied to determine the value of this point, alternating diarrhoea and constipation occurred in but 8 per cent of the cases.

Rectal carcinoma occurs so unobtrusively that any suspicious symptoms such as unusual sensations in the rectum, the occurrence of haemorrhoids, or the passage of blood, should make one investigate such events early and thoroughly.

Digital examinations of the rectum are so often repugnant to the patient and the examiner that they are frequently neglected, in the diagnosis of abdominal lesions of a surgical character no single examination is of greater value than thorough and adequate rectal examination and perhaps no step in the examination is more often omitted.

To increase the percentage of cures in cancer of the colon and rectum the lesions must be discovered earlier. This involves the more frequent employment of bismuth enemata. In any patient with an alteration of colonic function, bismuth enemata must be given—bismuth by mouth should never be given as a preliminary diagnostic measure because of the danger of producing complete obstruction. In any patient manifesting unusual rectal symptoms—the passage of blood the presence of haemorrhoids—digital and sigmoidoscopic examinations must be made and bismuth enemata given.

From a surgical point of view, carcinoma of the colon and rectum offers great hope of cure provided diagnosis is made early. Therefore as the signs of its presence in the early stages are so silent and as negative findings are often reported after thorough examinations it behooves patients to submit to complete examinations upon only suspicious evidence of the possible presence of cancer. The price of a higher percentage of cures for this lesion lies in the willingness of the patient to submit to digital and sigmoidoscopic examination and bismuth enemata.

FRANK H. LAHEY

LIVER FUNCTION AND "LIVER DEATHS"

IN spite of the tremendous amount of work that has been done in the attempt to interpret the functions of the liver it still remains chemically an organ of great mystery. The various tests of liver function are directed at one aspect of liver physiology and no test or a series of tests indicates with satisfactory certainty just what will be the biotic response of the liver to surgical intervention.

Tests of the excretory function of the liver such as the icteric index, urobilin in the urine and the dye tests such as phenoltetrachlor

phthalein or bromsulphthalein are useful both diagnostically and as a basis for a clinical estimation of some phase of liver capacity. Tests such as the galactose tolerance are also valuable as indicating the part played by the liver in carbohydrate metabolism while tests directed at the intermediate products of protein metabolism such as the nitrogen partition of the blood and of the urine are indeed valuable in regard to this aspect of liver physiology but are insufficient to answer the question as to what will be the physiologic response of the liver in the event that a laparotomy is performed.

From time to time various contributions have been made in medical and surgical journals with regard to this important question. The effect of a concomitant and associated jaundice adds a complicating factor to gall bladder surgery of tremendous importance. Irrespective as to the type or cause of the jaundice, the pernicious effect of an icterus upon the adequacy of liver function is one that is known to all clinicians.

From time immemorial coma and liver disease have been associated in the minds of clinicians, and not infrequently the surgeon has had an inexplicable death following rather simple gall bladder surgery and has been unable to comprehend either the cause of the mortality or the mechanism of its production. It has been the impression in the minds of surgeons that these obscure and inexplicable mortalities were in some way associated with either a failure of the liver to exercise its normal and adequate protective function or that as a result of anesthesia, trauma, absorption hemorrhage and disturbed intrahepatic physiology, the protection ordinarily afforded by the liver was inadequate.

For convenience a number of surgeons have grouped these chemical deaths under the generic term "liver deaths." This is not a good

designation and its only merit is for convenience of discussion. The most common type of chemical or so called liver deaths have been those associated with hyperpyrexia and coma. The operation has been one of relatively simple technical performance in a patient whose general metabolism was considered satisfactory before operation and in whom adequate renal function had been determined. Almost immediately from the time of operation there is a continuous ascending temperature with a rapidly developing lethargy, stupor and coma and death terminates the picture in from 18 to 36 hours. A second type, somewhat less frequent than the first, occurs in patients who have had an operation for the relief of obstructive jaundice and in the course of a rather normal convalescence and about the fourth or fifth day and in the presence of a constantly diminishing jaundice as indicated by the icteric index they slowly pass into a stupor and coma and the exodus is in no way dissimilar from the cholæmic death that occurs in unrelieved obstructive jaundice. A third type perhaps is associated with some unrelated kidney pathology for anuria is a factor in the terminal picture. Previous to operation these patients have had what was considered normal renal function and no question was in the mind of the surgeon as to the competency of the kidney to carry on its function in the presence of an operative intervention. Forty-eight hours after an operation on the gall bladder or common duct the patient quite rapidly presents the picture not dissimilar from shock, with cold clammy skin, gradual failure in water elimination and a rise in the urea nitrogen. The urinary output becomes less and less and a mild delirium develops with increased frequency of pulse and temperature and finally coma and death. These patients were not jaundiced either before or after operation and there is a distinct inter-

val of apparently normal postoperative conduct of from 24 to 36 hours between the operation and the onset of the terminal clinical picture

Whether these three types are clinical entities or not is not important at the present time. They serve as indications or examples of a complex chemical problem presented to gall bladder surgeons. It is a natural expectation that, with an increase in our knowledge of the physiology of the liver, certain laboratory tests will be made available that will indicate what we may speak of as the vital reaction of the liver to operative trauma.

There are many phases of these groups of deaths that suggest basically a disturbed protein mechanism. From time to time we have observed rather disturbing degrees of lethargy and mild stupor following operations where there has been extensive denudation of peritoneal surfaces and have rightly or wrongly attributed this postoperative condition to the absorption of varying amounts of altered peritoneal secretion. The entire subject of liver response and chemical deaths is one of intriguing interest as it offers ample opportunity for clinical research and astute clinical judgment.

CHAS. GORDON HYD

MEMOIRS

CHARLES DANIEL LOCKWOOD

IF I were asked to mention one of the most beloved versatile and productive of contemporary surgeons, I would think immediately of Charles Daniel Lockwood. When he died on June 11, 1932, after a few days' illness with erysipelas, the Pacific Coast and the entire West lost an outstanding figure who by his splendid surgical ability, his radiant personality, and his great and unselfish service to mankind, had carved his name indelibly on the hearts of thousands of people.

Dr. Lockwood was born in Effingham, Illinois, January 22, 1868. His father, John H. Lockwood, in his young manhood was a Methodist circuit rider who while carrying on his arduous ministerial duties met and married Ruth Locke in 1858. Eleven children were born to them. This pioneer preacher served three years as a chaplain in the Union Army during the Civil War, after which he took up a soldier's homestead in Kansas and founded the Kansas Wesleyan University at Salina, Kansas.

During the period of reconstruction immediately following the war, Charles Lockwood received his first impression of the seamy side of life in Kansas and it was at this time that he and his brothers sought to relieve their father as much as possible of their support.

The Lockwood family, in spite of its hardships and privations, was a very happy and jolly one. The mother, industrious, cheerful, witty and lovable, was a fit mate to her vigorous, forthright and considerate husband. Unselfishness, devotion and sincere religion ran through this typical Midwest American family like beautiful threads of gold. Indeed, no better background was needed to develop the sterling qualities which carried Charles to distinction and gallant leadership both in his profession and in his community. Even as a boy he was distinguished by an exuberance of spirit, a tireless energy and an unswerving ambition. He enjoyed all sports, particularly swimming, skating and horse back riding, in which he excelled.

At the age of twelve he determined to become a doctor. Thus, in 1890 he entered the Liberal Arts College of Northwestern University preparatory to studying medicine. He completed his course in 1893 whereupon he entered the medical department in the same university from which he was graduated in 1896. He



Chas. L. Loomis

secured an internship in the Cook County Hospital for one year and then became an assistant instructor in surgery for the next two years

In 1898 he married Miss Clara M. Sanford who was studying in the Illinois Training School for Nurses. She became deeply interested in his work and throughout his life was a devoted helpmate and comrade in all his professional endeavors and achievements. Both were keenly absorbed in elevating the standards of education for nurses. For over thirty years he was active as a teacher in the Pasadena Training School for Nurses and for a number of years he had maintained the Lockwood Scholarship for Nurses. In collaboration with Mrs. Lockwood he wrote a textbook on Surgical Technique for Nurses, which was published in 1931. Just a few weeks before he died he discussed this book with me and his kind and quiet eyes gleamed as he told me of his zest for the work, and his complete satisfaction in a task well done.

As he began to achieve success in his profession he became the stay and bulwark of his parents through their declining years. Later his many brothers and sisters at one time or another were wont to come to him for sympathy or financial aid and in his kindness and generosity he found pleasure in assisting them.

It is easy to trace the upward march of his professional career. Always the serious student ever striving to increase his scientific knowledge which was to equip himself for his surgical responsibilities, we find him in the vanguard of activities in his profession.

His contributions to surgical literature are numerous and varied and reveal his assiduity, versatility and conscientiousness. I have collected thirty-five of his monographs, which are very creditable contributions to abdominal, thoracic, plastic, urologic, neurosurgery and general surgery.

In organized medicine and scientific associations he always played an active part. His wide surgical experience, his ease in the discussion of a subject, his innate gentility and kindly dignity soon made his leadership recognized nationally and he was honored by many societies. He was one of the founders and the first president of the Pacific Coast Surgical Association, a past president of the Western Surgical Association and a member of many other scientific bodies including the American College of Surgeons. In recent years he had become very much interested in thoracic surgery and as an enthusiastic member of the American Society for Thoracic Surgery he had done much to widen this new domain.

His heroic and patriotic service during the World War is worthy of emphasis. At that time, although in his fiftieth year, he was among the first to volunteer and enlist. He organized the Red Cross Ambulance Company No. 1 in Allentown, Pennsylvania, and was sent overseas in charge of it. On arriving in France he organized and commanded the Pontanzen Hospital at Brest and was later sent to the Western Front in charge of a Mobile Surgical Unit, Team 2. Here his team performed, as he later reported, 500 operations for battle casualties. He and his

team were commended by General Pershing for gallant service and courage shown under shell fire

It was there on the Western Front that I first had the privilege of meeting and knowing him and as he and I were sent forward together on the same orders, we soon became comrades-in-arms. I shall never forget those epoch making and nerve-wracking days! When we reported to the chief surgeon he looked at Dr Lockwood's already silvery gray hair and immediately said to him "Major Lockwood I believe that the arduous duties at the front will be too much for you and I think it would be better to have you assigned to duty in one of the base hospitals." A less courageous man would have been fully satisfied with such an assignment but not Lockwood. His one absorbing ambition at that time was to be in the very thick of the fight and while he reassured the chief surgeon of his ability to meet the responsibilities the latter was not easily persuaded. However Lockwood's earnestness, enthusiasm and eagerness won him over and he was allowed to continue with me. I have slept in open barracks with him. I have seen him under the most trying conditions and never once did he flinch from duty nor consult his own convenience and comfort when a task was to be performed.

His undying zeal and enthusiasm again are revealed in his acceptance of an invitation extended to him in 1927 by Sir Wilfred Grenfell to come to Labrador. There he spent six weeks operating, treating and examining cases.

During the years following the war he participated in various civic activities and became a leader in the ranks of the American Legion. His activity was responsible in a large measure for the financing of the construction of the present American Legion building in Pasadena. On last Memorial Day he served as chairman of the program committee and paid special tribute to the soldier dead.

Scarcely a fortnight later he joined their ranks. His death caused the most profound and widespread sorrow. None mourned his death more sincerely than the poor of his community to whom he always had been a true friend. His funeral was a most impressive and beautiful manifestation of the high public regard in which he was held. In their attendance at his last rites his colleagues, friends and admirers expressed their esteem for and love of this great surgeon, civic leader and zealous patriot.

One observes in the career of Charles D. Lockwood an epitome of the blessings of a full life—a life characterized to the end by kindness and sincerity, unselfishness and restraint, energy and productivity. I know of no one in our profession who was given so completely to simple living and to high thinking. One can see by his life as one could see by his face the reflection of his mind—a mind whose every thought was devoted to the highest humanitarian motives and to all the requirements of a higher civic duty. Such a life is indeed worthy of emulation by all American surgeons.

EDGAR LORRINGTON GILCREEST

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REVIEWS OF NEW BOOKS

NO member of the medical profession is better qualified than Franklin H. Martin to write a worth while autobiography.¹ From the very beginning of his long and busy life there were incidents worth recording which unmistakably forecast the figure he became in later years. In the first place he has lived through the most interesting of all periods of medicine and has had a liberal share in making modern surgery what it is today. Few men have had the opportunity to know personally and claim as loyal friends so many of the leaders in scientific thought and endeavor throughout the world.

The days of great adventure are thought by some to have ended but to such a man as Franklin H. Martin, life itself is a great adventure, and one which his buoyant spirit undertook with joyous unconcern for anything but living the daily life cleanly completely and honestly. And this great adventure has been one far different from destroying real or imagined evils. It has been largely making good things where there have been few things before and improving those things that were and yet were not perfect.

Dr. Martin's life is so fully set forth and with such instinctive artistic pleasure in his autobiography that we need not do more than call attention here not merely to its infinite variety but more especially to the unaffected courage with which he met conditions as they came. Conspicuous by its absence in the book is any note of complaint, or any indication even that the writer felt he was called upon to endure great hardships in making bricks or teaching school. It all came as a part of the job. It was all enjoyed. It all served literally to feed the man.

This autobiography will naturally appeal to physicians especially those who have labored with him but it will have a wider interest to the public by reason of its literary merit the delightful details of home life on the frontier the dogged perseverance and resourcefulness of a youngster who accepted life cheerfully and did his best whether the task was turning ax handles or making bricks. The story of his life as a teacher investigator contributor to medical literature organizer and leader of men is simply told his work and close associations with the men who directed the political and military destinies of the World War makes an extremely interesting

and authoritative addition to the history of this period.

All of America knows what this man has meant not merely to the profession but to the social improvement of his generation. Franklin H. Martin founded and established the greatest surgical journal, conceived the needs of post-graduate instruction, and organized the Clinical Congress of Surgeons of North America, appreciated the demands for improved hospital service and higher qualifications for those who practiced surgery and organized the American College of Surgeons. Either one of these accomplishments might have satisfied the most ambitious man but this tireless worker persistent dreamer and loyal champion of professional ideals still carries on. It would be a trite saying in view of the record which is given in the pages of this fascinating autobiography to remark that no task seemed mean to Franklin Martin. It is simple justice to say that he has proved that no task was too great, and, as we read the pages, the patience human kindness, and courage of the boy and the man are made to shine forth unmistakably.

C. JEFF MILLER

AMERICAN physicians and surgeons have long recognized the need of an authoritative comprehensive work on the practice of obstetrics and gynecology.² The appearance of the first two volumes³ warrants the observation that such a work, representing the best practice in America, is an actuality. Each section is a monograph by an authority in the field discussed and but few publications of American medicine have shown such careful editing with so high a degree of correlation.

A perusal of Volume II cannot fail to impress the reader with the utility of the subject matter for both the general practitioner and the specialist. The science of obstetrics and gynecology has been placed boldly in the foreground while at the same time practical procedures time tested and known to be effective form the ground work. Oliver Wendell Holmes once said "It is useful to have science in an upstairs room just so long as there is plenty of common sense on the ground floor." It is safe to say that but few medical publications with so strong a clinical emphasis have set forth so large a proportion of original work. A high percentage of the

¹ OBSTETRICS AND GYNECOLOGY. Edited by Arthur H. Curtis. M. D. Vol. II. Philadelphia: W. B. Saunders Company 1933.

² Volume I was reviewed in *Surgery, Gynecology and Obstetrics* for July 1932, by William Wallace Chipman.

THE JOY OF LIFE. AN AUTOBIOGRAPHY. In two volumes. By Dr. Franklin H. Martin. Garden City New York: Doubleday Doran, and Company 1932.

authors are eminent clinical investigators and the amount of new material, hitherto unpublished in book form is unusually large.

Volume II opens with a carefully studied monograph by Charles B. Reed and William Serbin on "Dystocia from Contracted Pelvis." Edmund Piper in his *Anomalies of the Passenger* presents a frank and refreshing treatise on this subject. He has carefully summarized the views of the leaders in midwifery detailing his own painstaking procedures with great modesty. Benjamin P. Watson presents an epoch-making monograph on "Puerperal Infection and Thrombophlebitis." He writes from a broad academic and clinical experience first in a well known Canadian medical school, then at the University of Edinburgh and now at the Sloane Maternity. His presentation is scholarly thorough, and conclusive. William C. Danforth contributes a valuable chapter on the Forceps. Many of the illustrations used are original and add greatly to a clear understanding of the exact and specific procedures described. Two of the most important chapters in the volume are "Gonorrheal Disease of the Female Genitalia," by the editor Arthur H. Curtis, and "Syphilis in Women" by George Gellhorn. The former presents many new views with rare clarity and directness and the latter represents a lifetime study by an eminent authority. In the chapter entitled "The Cellulitis Group" the editor Dr. Curtis, discusses the gynecological aspects of puerperal infection, correlating with and supplementing Dr. Watson's admirable chapter. Norman Miller the new head of the department of obstetrics and gynecology at the University of Michigan, protégé and distinguished pupil of the beloved Reuben Peterson, contributes a valuable chapter on "Nonspecific Infections." James Robert Goodall, known throughout the scientific world for his work on the ovary contributes the chapter on "Tumors of the Ovary."

It is safe to say that no one could have presented this difficult and complicated subject more effectively. The chapter on "Carcinoma of the Cervix" presented by Karl H. Martaloff contains a mine of information on this important subject. In a footnote Dr. Martaloff makes gracious mention of the assistance of the editor. "Tumors of the Fallopian Tubes, Ligaments, and Pelvic Cellular Tissues" is presented by the head of the department of obstetrics and gynecology of the University of Oregon Medical School. In this important article Dr. Watkins has demonstrated his ability as a clear and forceful writer.

It is a matter of deep regret that William P. Graves, brilliant writer and teacher did not survive to see his unique chapter on "Uterine Myomata (Fibroids)" in print. The beautiful illustrations drawn by Dr. Graves add greatly to the value of the article. Dr. Graves spent the better portion of a year on this important chapter and felt a justifiable sense of pride in his accomplishment. In connection with the lamented death of Dr. Graves, students of obstetrics and gynecology will note the absence of contributions by two men whose work has brought distinction to American obstetrics and gynecology. The recent passing of J. Whitridge Williams, of Baltimore, and of John Polak, of Brooklyn, prevented the inclusion of planned contributions from their pens.

Finally mention must be made of the delightful "chatty" chapter entitled "History of American Gynecology: a Brief Outline" by Howard Kelly. Dr. Kelly presents an intimate view of the rise and progress of gynecology in America, in most of which he has been an active participant.

The publishers are to be congratulated upon the unusual excellence of the illustrations, the clear legible typography and the attractive make-up of the volume.

LEWIS S. CUTLER

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

LESIONES DEL FONDO DE OJO OBSERVADAS EN VENEZUELA. By Dr. J. M. Espino. Caracas, Venezuela. Lit. y Tip. del Comercio, 933.

University College Hospital. REPORT ON RADIO-THERAPY FOR 1933. By Gwenda Hilton, M.B., B.S., B.Sc., D.M.R.E. and Robin Pitcher M.S., F.R.C.S. M.R.C.P. London: John Bale, Sons & Danielsson, 1933.

HISTORY AND SOURCE BOOK OF ORTHOPEDIC SURGERY. By Edgar M. Bick, M.A., M.D. New York: The Hospital for Joint Diseases, 935.

THE CONTROL OF FOOTBALL INJURIES. By Marvin Allen Stevens, M.D., and Winthrop M. Ryan Phelps, M.D. New York: A. S. Barnes and Company, 933.

THE OPERATIVE STORY OF CLIFF PALATE. By George M. Dornice, M.D. F.A.C.S. Assisted by Enayot Shlinsky, D.D.S. Philadelphia and London: W. B. Saunders, 933.

GYNECOLOGICAL OPERATIONS. ed. ed. By Henri Hartmann. Paris: Masson et Cie, 1933.

FRACTURES. By Paul B. Magnusson, M.D. Philadelphia, Montreal, London: J. B. Lippincott Company, 1933.

OPERATIVE SURGERY THE ABDOMEN AND RECTUM. By Dr. Martin Kirschner. Authorized Translation by L. S. Ravdin, B.S., M.D. Philadelphia and London: J. B. Lippincott Company, 1933.

MODERN SURGICAL MONOGRAPHS. Edited by G. Gordon-Taylor O.B.E., M.A. F.R.C.S. SURGERY OF THE THORAX. By T. Holmes Sellers, M.Ch., M.A. (Oxon.) F.R.C.S. (Eng.) London: Constable and Co. Ltd. 1933.

THE STORY OF CHILDREN. By Dr. Palmer Floddy. Garden City New York: Doubleday Doran & Co., 1933.

DISEASES OF THE NERVOUS SYSTEM. By W. Russell Brain, M.A. D.M. (Oxon.) F.R.C.P. (Lond.) London: Oxford University Press, 1933.

THE THYROID GLAND; ITS CHEMISTRY AND PHYSIOLOGY. By Charles Robert Hartington, M.A. Ph.D. F.R.S. London: Oxford University Press, 1933.

MYEOMATOUS OVARIOECTOMY. Po Metodou Polukhrono Infiltrata. By Prof. A. W. Wladjewsky.

GYNECOLOGY FOR NURSES. By George Gellhorn, M.D. F.A.C.S. 2d rev. and enl. ed. Philadelphia and London: W. B. Saunders Co., 933.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

J BENTLEY SQUIER New York, *President*

WILLIAM D HAGGARD Nashville *President Elect*

FRANKLIN H MARTIN Chicago *Director-General*

PHILIP H KREUSCHER *Chairman* OSCAR E NADZAU *Secretary Committee on Arrangements*

PRELIMINARY PROGRAM FOR THE CLINICAL CONGRESS IN CHICAGO

THIS year the American College of Surgeons celebrates its twentieth anniversary—the first Convocation having been held in Chicago in November 1913. In celebration of this anniversary the surgeons of Chicago will present for the twenty third annual Clinical Congress of the American College of Surgeons, October 9-13 a program of clinics and demonstrations in the hospitals and medical schools that will provide a complete showing of clinical activities in all departments of surgery, in this great medical center. A preliminary schedule of operative clinics and demonstrations, as prepared by the Committee on Arrangements is presented in the following pages. It will be noted that clinics are scheduled to begin at 2 o'clock on the afternoon of Monday October 9 continuing through the four following days with sessions both morning and afternoon.

The surgeons of Chicago are keenly interested to outdo all previous efforts, and in making its plans the Committee has the hearty co-operation of the clinicians in the medical schools and more than fifty hospitals that will participate in the clinical program.

The clinical program contains many features of special interest including (1) Cancer clinics demonstrating the treatment of cancer cases by surgery, radium and X-ray (2) fracture clinics where modern methods in the treatment of fractures will be demonstrated (3) clinics in traumatic surgery demonstrating the newer methods of rehabilitation by surgery and physiotherapy of patients injured in industrial automobile and other accidents.

Special features of the general program for the Congress include (1) A conference on fractures on Tuesday afternoon arranged by the College Committee on the Treatment of Fractures (2) a symposium on the curability of cancer on Wednesday afternoon the program for which will be

found on another page (3) a symposium on the teaching of surgery and the surgical specialties on Thursday afternoon following the annual meeting (4) a symposium on urological surgery on Friday morning the program for which appears on another page (5) a symposium under the auspices of the Board on Industrial Medicine and Traumatic Surgery on Friday afternoon (6) a daily exhibition of surgical motion picture films both sound and silent.

Two sub-committees have been appointed to supervise the program for the sections on surgery of the eye ear nose and throat as follows: Ophthalmology—Harry S Gradle chairman Thomas D Allen E K. Fundlay Sanford Gifford. Otolaryngology—Joseph Beck chairman Austin A Hayden, Edward P Norcross, S J Pearlman. The recommendations of these committees insure a worth-while program of clinics and scientific sessions for all those interested in these specialties.

EVENING MEETINGS

A preliminary outline of the programs for a series of five evening meetings to be held in the ballroom of the Stevens Hotel, as arranged by the Central Executive Committee of the Congress will be found on a following page.

At the presidential meeting on Monday evening at which the president-elect Dr William D Haggard of Nashville Tenn. is to be inaugurated a number of distinguished visiting surgeons from foreign countries will be presented. Among those who have indicated their intention of being present are Dr Lorenz Boehler Vienna Prof Dr Eugen Kisch, Graefenberg Bohemia Mr G L Keynes, London Mr Adams A McConnell Dublin Ireland Prof Nissen Berlin Germany Prof Dr Wolfgang Rosenthal Leipzig Germany Prof H Beckwith Whitehouse Birmingham England. The annual John B Murphy oration

in surgery "The Story of a Master Surgeon, to be delivered by Dr. Loyal Davis of Chicago will be another feature of this session.

At the annual Convocation of the College on Friday evening at which the 1933 class will be received into Fellowship in the College, the Fellowship address will be delivered by Robert Maynard Hutchins, A.M. LL.D. president of the University of Chicago and the presidential address by Dr. William D. Haggard.

Programs are being prepared for sessions on Tuesday and Thursday evenings at the Stevens Hotel at which papers and discussions will deal with subjects of special interest to ophthalmologists and otolaryngologists.

SYMPOSIUM CANCER IS CURABLE

Eminent surgeons of wide experience in varied fields of surgical practice and representing all parts of the United States and Canada will contribute to this symposium to be held in the ballroom of the Stevens Hotel on Wednesday afternoon at 2:30 presenting reports as to cases of cancer cured for a period of five years or longer. Among those participating in the symposium are the following:

- ROBERT B. GREENWOOD, M.D. Boston Chairman of Committee on the Treatment of Malignant Diseases, presiding
General Subject of Curability of Cancer FRANKLIN H. MARTIN, M.D. Director General
Cancer as an Arrestable Disease CHARLES A. DUKES, M.D. Oakland, Calif.
General Cases of Five Year Cures IRVIN ABELL, M.D. Louisville, Ky. FRANK K. BOLAND, M.D. Atlanta, Ga. FREDERICK A. COLLIER, M.D. Ann Arbor, Mich.
JOHN JOSEPH GALLAGHER, M.D. Salt Lake City Utah CHEVALIER JACKSON, M.D. Philadelphia
CHARLES C. LUND, M.D. Boston DANIEL B. PHELPS, M.D. Philadelphia, EUGENE H. POOL, M.D. and JOHN A. VINTON, M.D. New York ALISON R. KILGORE, M.D. San Francisco.
Cancer of the Breast MALVERN B. CLOXTON, M.D. St. Louis, E. STARR JUDD, M.D. Rochester Minn. JAMES MONROE MASON, M.D. Birmingham, Ala., JOHN T. MOORE, M.D. Houston, Tex. RICHARD R. SMITH, M.D. Grand Rapids, Mich.
Cancer of the Pelvic Organs and Breast BROOKS M. ANDRACH, M.D. Philadelphia HARRY S. CROSBY, M.D. St. Louis, WILLIAM P. HEALY, M.D. New York.
Cancer of the Pelvic Organs JAMES C. MASON, M.D. Rochester, Minn.
Cancer of the Rectum ROBERT C. CONFEY, M.D. Portland, Ore.
Cancer of the Thyroid Gland and Large Intestine JOHN DEJ. PRITCHETT, M.D. Rochester Minn.
Cancer of the Thyroid MARTIN B. TUCKER, M.D. Ithaca, N.Y.
Cancer of the Mouth, Tongue and Lips WILLIAM H. G. LOGAN, M.D. Chicago
Malignant Bone Tumors WILLIAM B. COLEY, M.D. New York.

FRACTURE CONFERENCE AND DEMONSTRATIONS

A conference on fractures, under the auspices of the College Committee on the Treatment of Fractures, of which Dr. Frederic W. Bancroft of New York is chairman is to be held in the ballroom of the Stevens Hotel on Tuesday afternoon beginning at 2:30. Among the speakers who will participate in this conference and their subjects are as follows:

- CHARLES L. SCUDDY, M.D. Boston The Accomplishments and Ideals of the Regional Fracture Committees
ROBERT H. KENNELLY, M.D. New York The Transportation of Early Long Bone Fractures the co-ordination of the activities of the Committee on the Treatment of Fractures of the American College of Surgeons with (a) the Red Cross, (b) the railroad association, (c) ambulances and morticians.
WILLIAM L. EYER, JR., M.D. Bethlehem, Pa. The After-Care in Preventing Disabilities Following Fractures
ISIDORE COMTE, M.D. New Orleans Clinical Examination versus X-ray Examination in Fractures During Childhood
FREDERICK J. TIER, M.D. Montreal Dislocation of the Radiocarpal Joint.

The annual fracture oration will be delivered by Dr. W. Edward Galhe of Toronto on Wednesday evening his subject being "The Treatment of Fractures Involving Joints."

The treatment of fractures will also be the subject of daily demonstrations in the exhibition hall of the Stevens Hotel arranged by the Chicago Regional Fracture Committee. In addition, illustrated talks on fractures by members of this Regional Committee will be given twice daily at hours to be announced in the daily clinical bulletin. In several of the hospitals special fracture clinics have been arranged at which modern methods in the treatment of fractures will be demonstrated.

ANNUAL HOSPITAL CONFERENCE

The program for the sixteenth annual hospital conference arranged by the Hospital Standardization Department of the College, as presented in the following pages, presents a group of interesting papers, round table conferences and practical demonstrations that deal with the important problems related to hospital efficiency.

The conference opens at 10 o'clock on Monday morning in the ballroom of the Stevens Hotel, continuing on Tuesday Wednesday and Thursday. Papers will deal with the vital problems affecting administrative, professional and the nursing phases of hospital work with particular emphasis directed toward professional standards and the highly important problem of medical economics.

The program provides for sessions in the ball room of the Stevens Hotel on Tuesday, Wednesday and Thursday mornings. For the afternoons an important and interesting series of demonstrations in several of the local hospitals dealing with departmental organization, management and function will be arranged. These clinics in hospital administration afford unusual opportunities for the visitors to see how local hospitals handle their daily routine and in comparison, to appreciate the efficiency of their own methods.

The program of the conference has been carefully planned to give it a broad interest with a careful selection of subjects to be discussed by eminent authorities in the surgical and hospital field. Greatly increased interest on the part of surgeons in both administrative and scientific phases of hospital work has been evident in recent years. The program to be presented this year will be unique in providing a discussion of many subjects of importance to the three major groups of the hospital—medical nursing and business. An opportunity is also afforded to chiefs of staffs, heads of departments and members of staffs to participate in a program dealing particularly with the care of the patient, and may expect to benefit from an exchange of ideas with trustees, superintendents and others concerned with hospital administration.

COMMUNITY HEALTH MEETING

Following the established custom of the American College of Surgeons, in recognition of its obligation to the public to provide authoritative information on modern surgery, better hospitals and prevention of disease a community health meeting will be held on Wednesday evening, October 11, in connection with the Clinical Congress. For this purpose the Chicago Stadium, which will accommodate approximately twenty thousand has been secured. A program appropriate for such an occasion is being prepared consisting of brief interesting talks on scientific medicine, health and hospitals by speakers of note. These talks will be supplemented by an interesting new sound motion picture on modern hospital care.

SURGEONS' WEEK AT A CENTURY OF PROGRESS

A Century of Progress has made an admirable and fitting contribution to medicine and surgery through the medical exhibits in the Hall of Science. Since the opening of the exposition thousands of people view these exhibits daily with intense interest and no doubt go home with a more rational viewpoint of scientific medicine.

Another contribution by A Century of Progress will be Surgeons' Week, commencing October 8 which will be opened by a large assembly in the court of the Hall of Science on Sunday evening when an appropriate and interesting program will be presented following the Arcturus ceremony. Among other interesting features of this program will be addresses by distinguished surgeons from Central and South America, Australia, Great Britain and the Continent. Throughout the week at A Century of Progress talks and radio broadcasts will be given by Fellows of the College in connection with the daily program. All the Fellows of the College, their families and friends, are invited to attend the Sunday evening assembly in the court of the Hall of Science.

HEADQUARTERS—HOTELS

General headquarters for the Clinical Congress will be established at the Stevens Hotel located on Michigan Avenue between Seventh and Eighth Streets. This hotel affords unusual facilities for all activities of the Congress, as will be remembered by those who attended the Congress in Chicago in 1929. The grand ballroom on the second floor with other large rooms on the third floor and the exhibition hall have been reserved for the exclusive use of the Congress. All of the evening sessions, the hospital conference on Monday, the annual meeting, the cancer and fracture symposia will be held in the grand ballroom. The registration and information bureau, together with the bulletin boards on which will be displayed the daily clinical program will be established in the exhibition hall together with the Technical Exhibition.

Chicago has many fine large hotels, several within walking distance of the headquarters hotel. A list of the hotels recommended by the Committee on Arrangements is presented here with. While Chicago's hotel facilities are very great and there should be no difficulty in securing first-class hotel accommodations, it is advisable for those who expect to attend the Clinical Congress to reserve their hotel accommodations as far in advance as possible as A Century of Progress Exposition will undoubtedly bring to Chicago a very large number of visitors.

The Technical Exhibition of the Clinical Congress will be located in the Exhibition Hall together with the registration and information bureau. In the same room will be found the bulletin boards on which the daily clinical programs will be posted each afternoon. The leading manufacturers of surgical instruments, ray apparatus

CHICAGO HOTELS AND THEIR RATES

| | Midweek Rate With Bath | Single | Double |
|--|---------------------------|--------|--------|
| Ambassador North State Street at Goethe | \$3.50 | \$6.00 | |
| Auditorium, Michigan Blvd. and Congress | 3.50 | 6.00 | |
| Belden Stratford, 3300 Lincoln Park West | 4.00 | 6.00 | |
| Belmont, Sheridan Road at Belmont | 4.00 | 5.00 | |
| Bismarck, Randolph at LaSalle St | 3.50 | 5.00 | |
| Blackstone Michigan Blvd. and 7th St | 3.50 | 5.00 | |
| Brevort, 30 West Madison St | 2.50 | 3.50 | |
| Congress, Michigan Blvd. and Congress | 4.00 | 6.00 | |
| Drake, Lake Shore Drive and Michigan | 3.00 | 5.00 | |
| Edgewater Beach, 5300 Sheridan Road | 4.00 | 6.00 | |
| Crest Northern, Jackson and Dearborn | 3.50 | 4.00 | |
| Knickerbocker 163 East Walton | 3.00 | 5.00 | |
| LaSalle LaSalle at Madison St | 2.50 | 4.00 | |
| Madison, 70 West Madison St | 3.00 | 4.50 | |
| Palmer House State and Monroe Sts | 3.50 | 6.00 | |
| Pennon, 30 East Pearson St | 3.00 | 5.00 | |
| Stevens, Michigan Blvd bet. 7th and 8th | 3.50 | 5.00 | |

operating room lights, hospital apparatus and supplies of all kinds, ligatures, dressings, pharmaceuticals, and publishers of medical books will be represented in this exhibition.

We are assured that the railways of the United States and Canada will grant especially low rates on account of the Clinical Congress in connection with A Century of Progress Exposition in Chicago. Applications for reduced fares are pending before the railway traffic associations.

ADVANCE REGISTRATION

The hospitals of Chicago afford accommodations for a large number of visiting surgeons, but to insure against overcrowding the attendance will be limited to a number that can be comfortably accommodated at the clinics—the limit of attendance being based upon the results of a survey of the amphitheaters, operating rooms, and laboratories of the hospitals and medical schools to determine their capacity for visitors. It is expected therefore, that those surgeons who wish to attend the Clinical Congress in Chicago will register in advance.

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics and insures against overcrowding, as the number of tickets issued for each clinic will be limited to the capacity of the room in which that clinic will be given.

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each sur-

geon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card, which is non transferable, must be presented in order to secure clinic tickets and admission to the evening meetings.

COMMITTEE ON ARRANGEMENTS

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| JOSEPH J. LEONARDE | CHARLES B. YOUNGER |
| | A. G. ZIMMERMAN |

PRELIMINARY PROGRAM FOR EVENING MEETINGS

IN THE BALLROOM OF THE STEVENS HOTEL AT 8 15

Presidential Meeting Monday October 9

Address of Welcome. PHILIP H. KREUSCHER M D Chairman of Committee on Arrangements

Introduction of Foreign Guests. FRANKLIN H. MARTIN M D Director General

Address of Retiring President J. BENTLEY SQUIER, M D New York

Inauguration of Officers

Inaugural Address Surgery the Queen of the Arts. WILLIAM D. HAGGARD M D Nashville Tenn.

John B. Murphy Oration in Surgery The Story of a Master Surgeon. LOYAL DAVIS M D Chicago

Tuesday Wednesday and Thursday October 10 11 and 12

Symposium on Vascular Diseases

Thrombo-Angiitis Obliterans (Buerger's Disease) GEORGE E. BROWN M D Rochester Minn.

Ligation of Large Arteries. MONT. ROGERS REID M D Cincinnati

Symposium on Diseases of the Thyroid

Hyperthyroidism and Associated Diseases GEORGE W. CRILE M D Cleveland

The Treatment of Exophthalmos. HOWARD C. NAFFZIGER, M D San Francisco

Tumors of the Parathyroid Glands EDWARD D. CHURCHILL, M D Boston

Mastopathy and Chronic Mastitis H. BECKWITH WHITEHOUSE, M S F.R.C.S. Birmingham, England.

The Common Syndrome of Rupture Dislocation and Elongation of the Biceps Brachii an Analysis of Fifty Cases. EDGAR L. GILCREEST M D San Francisco

Title to be announced GEOFFREY L. KEYNES, M D F.R.C.S. London, England

Sympathectomy in Children DAVID EDWIN ROBERTSON M D Toronto

Fracture Oration The Treatment of Fractures Involving Joints. W. E. GALLIE M D F.R.C.S (Eng)
Toronto Ontario

Convocation—Friday October 13

Invocation

Conferring of Fellowships

Conferring of Honorary Fellowships

Presidential Address Surgeon of the Wilderness—Ephraim McDowell. WILLIAM D. HAGGARD M D
Nashville Tenn.

Fellowship Address. ROBERT MAYNARD HUTCHINS A M LL D President University of Chicago

SYMPOSIUM ON UROLOGICAL SURGERY

BALLROOM STEVENS HOTEL, FRIDAY 11 A.M.

JOHN R. CAULK, M D St. Louis Transurethral Surgery

FRANK HINMAN M D San Francisco The Pathogenesis of Hydronephrosis.

JOSEPH F. MCCARTHY M D New York The Prostate Gland—Its Place in General Medicine Newer
Conception of Diagnosis and Therapy

ANNUAL HOSPITAL STANDARDIZATION CONFERENCE

Monday 10:00-12:30—Ballroom Stevens Hotel

- J. BRANTLEY SQUIER, M.D. New York, President, American College of Surgeons, presiding
 Address of Welcome J. BRANTLEY SQUIER, M.D. New York
 The 1933 Hospital Standardization Survey and Announcement of List of Approved Hospitals FRANKLIN H. MARTIN, M.D. Chicago Director General, American College of Surgeons
 The Hospital Standardization Movement in Relation to the Practice of Internal Medicine WALTER L. BIRKENRO, M.D. Des Moines, Iowa
 Opportunities of the Surgeon and the Hospital in Promoting Community Interest in the Proper Care of the Sick and Injured BERT W. CALDWELL, M.D. Chicago
 Preparation for a Surgical Career WILLIAM D. HAGGARD, M.D. Nashville, Tenn.
 The Modern Philosophy of Medicine REY ALPHEUSSE M. SCHWITALLA, S.J. Ph.D. St. Louis
 A Century of Progress ELLIS J. CARNEY, M.D. Milwaukee Wis.
 The Next Century of Progress in Medicine GEORGE W. CABLE, M.D. Cleveland

Monday 2:00-5:00—Ballroom Stevens Hotel

- ROBERT B. GREENKOPF, M.D. Boston, presiding.
 Round Table Conference Medical and Hospital Economics—Minimizing as low hospital charges as are consistent with good care of the patient—from the standpoint of
 The Surgeon ALEXANDER W. BLAIN, M.D. Detroit, Mich.
 The Internist S. MARK WHITE, M.D. Minneapolis, Minn.
 The Specialist AUSTIN A. HAYDEN, M.D. Chicago.
 The Radiologist H. B. PODARSKY, M.D. Milwaukee Wis.
 The Pathologist J. J. MOORE, M.D. Chicago.
 The Hospital Management PAUL H. FESLER, Chicago
 Hospital Economics as Applied to the Small Hospital CLYDE F. SMITH, Waterloo, Iowa.
 Prepayment Plans for Hospital Service WILIAM H. WALKER, M.D. Chicago
 The Alameda Plan CHARLES A. DUBLER, M.D. Oakland, Calif.

Tuesday 9:30-12:30—Ballroom Stevens Hotel

- ALEXANDER R. MCKEON, M.D. Edmonton, Alberta, presiding
 The Application of Hospital Standardization in the Small Hospital MAURICE T. LEWIS, Princeton, Ind.
 The Hospital Annual Report CHARLES E. RENDY, M.D. Minneapolis, Minn.

- Convalescent Care for the Patient G. HARVEY ABBEY, M.D. Toronto, Ontario.
 The Organization, Management, and Functioning of the Department of Anesthesia in a 300 Bed Hospital BEVERLY LITTON, M.D. Regina, Saskatchewan
 The Organization, Management, and Functioning of the Clinical Laboratory ROBERT I. GILSON, M.D. Oakland, Calif.
 Clinical and Clinico-Pathologic Conferences. OLIVER W. LORER, M.D. Saginaw Mich.

Tuesday 2:00-5:00

- Demonstrations and round table conferences in local hospitals—dealing with departmental organization, management, and functioning; business methods in hospitals; admitting and discharging patients; organization and management of the dietary department and food service; operating room management and procedures.

Wednesday 9:30-12:30—Ballroom Stevens Hotel

- Joint Conference—American College of Surgeons and Association of Record Librarians of North America R. C. BURRIE, M.D., Madison, Wis., presiding
 Plan and Scope of the Record Department. MARY M. NEWTON, Pittsburgh, Pa.
 A Survey of Cancer Records in Hospitals. PRISCILLA WIER, New York.
 The Importance of Accurate and Complete Records on Fracture Cases. FRANK D. DICKSON, M.D. Kansas City Mo.
 The Importance of Accurate and Complete Obstetrical Records. JOHN R. FRASER, M.D. Montreal, Quebec.
 Round table conference—problems associated with the obtaining of good clinical records in hospitals.

Wednesday 2:00-5:00

- Demonstrations and round table conferences in local hospitals dealing with departmental organization, management, and functioning; organization and management of the clinical record department, nursing care of the patient, management of the obstetrical department, organization and management of the central supply room.

Thursday 9:30-12:30—Ballroom Stevens Hotel

- Round table conference—administrative, medical, nursing, economic, and social problems affecting hospitals. Conducted by ROBERT JOLLY Houston, Texas, and R. C. BURRIE, M.D., Madison, Wis.
 Motion picture (sound)—showing what constitutes modern, scientific care of the patient.

Thursday 2:00-5:00

- Demonstrations and round table conferences in local hospitals dealing with departmental organization, management, and functioning of the social service department, of the interns service of the housekeeping department, public relations.

PRELIMINARY CLINICAL PROGRAM

GENERAL SURGERY, GYNECOLOGY OBSTETRICS ORTHOPEDICS UROLOGY
PROCTOLOGY, SURGICAL PATHOLOGY ETC

COOK COUNTY HOSPITAL

Monday

SUMNER L. KOCH—2. General surgery
F. H. FALLS—2. Gynecology
E. J. BERKHESMER—2. Orthopedics
WILLIAM R. CURRIE—2. General surgery
MARSHALL DAVISON—2. General surgery

Tuesday

SUMNER L. KOCH—2. Diagnostic clinic.
R. W. MCNEALY—2. General surgery
AARON KAMTER—2. Gynecology
GEORGE DAVIS—2. General surgery
A. H. MONTGOMERY—2. General surgery
A. H. CONLEY—2. Orthopedics
CAREY CULBERTSON—2. Gynecology
J. O'DONOGHUE—2. General surgery
HARRY CULVER—2. Urology
H. JACKSON—2. General surgery
MARCUS HOBART—2. Orthopedics
VERNON C. DAVID—2. Diagnostic clinic.
DR. GATEWOOD—2. General surgery
J. P. GREENHILL—2. Gynecology
RALPH B. BITTMAN—2. Surgery in tuberculosis.
E. WARSZEWICK—2. General surgery

Wednesday

CHAMBERLAIN BARRETT—2. Gynecology
HARRY CULVER—2. Urology
V. L. SCHLAGER—2. General surgery
GEORGE APPELBACH—2. General surgery
J. G. FROST—2. General surgery
R. C. SULLIVAN—2. General surgery
L. L. VESTER—2. Urology
FRANK JIRKA—2. General surgery
R. VAUGHAN—2. General surgery
PHILIP H. KREUSCHER—2. Orthopedics
CHARLES M. MCKENNA—2. Urology
H. ROBINSON—2. Urology
HARRY CULVER—2. Urology
GEORGE DAVIS—2. General surgery
J. R. BUCHHEIMER—2. General surgery
DAVID HILLIS—2. Obstetrical operations.
SUMNER L. KOCH—2. General surgery

Thursday

PHILIP H. KREUSCHER—2. Orthopedics
CHAMBERLAIN BARRETT—2. Gynecology
GEORGE DAVIS—2. General surgery
R. W. MCNEALY—2. General surgery
MARCUS HOBART—2. Orthopedics
D. HOKER—2. Gynecology
KARL A. MEYER—2. General surgery
E. W. FISCHMAN—2. Gynecology
A. H. MONTGOMERY—2. General surgery
MAX THORPE—2. General surgery
A. H. CONLEY—2. Orthopedics
D. H. LEVINTHAL—2. Orthopedics
JOHN HARGER—2. General surgery
F. H. FALLS—2. Gynecology
E. J. BERKHESMER—2. Orthopedics
RALPH BITTMAN—2. General thoracic surgery
WILLIAM R. CURRIE—2. General surgery

Friday

GEORGE APPELBACH—2. General surgery
AARON KAMTER—2. Gynecology
R. C. SULLIVAN—2. General surgery
CAREY CULBERTSON—2. Gynecology
VERNON C. DAVID—2. General surgery
MARCUS HOBART—2. Orthopedics
F. G. DYER—2. General surgery
J. O'DONOGHUE—2. General surgery
H. JACKSON—2. General surgery
DR. GATEWOOD—2. General surgery
JOHN HARGER—2. General surgery
J. R. BUCHHEIMER—2. General surgery
MARSHALL DAVISON—2. General surgery
E. WARSZEWICK—2. General surgery
SUMNER L. KOCH—2. General surgery

CHICAGO MEMORIAL HOSPITAL

Monday

JULIA C. STRAWN and PAUL M. CLIVER—2. Gynecological clinic.

Tuesday

ARTHUR H. CONLEY and FRED M. MILLER—2. Orthopedic and industrial injury clinic.
JAMES E. FITZGERALD—2. Obstetrical clinic
JOHN P. O'NEIL, J. WILLIAM PARKER and DONNIN F. RUDNICK—2. Urological clinic

Wednesday

CHARLES E. KAHLE, LAWRENCE L. FREEMAN, ROBERT A. MCKENNY and M. L. WEINSTEIN—2. General surgical clinic.
FRANK WRIGHT—2. Colloidal state of the blood in post operative pneumonia.
GEORGE M. LANDAU—2. Phrenico exsterna and treatment of unilateral tuberculosis.

Thursday

C. R. G. FORRESTER—2. Fracture clinic.
CARVER M. EPSTEIN—2. Oral and plastic surgery
CHARLES J. DRUTSK, SR.—2. Proctology
HARRY L. MEYERS—2. Gynecological clinic
WILLIAM L. BROWN—2. Radium clinic

Friday

PETER S. CLARK, BENNETT R. PARKER and LEO M. ZIMMERMAN—2. General surgical clinic.

ALBERT MERRITT BILLINGS HOSPITAL

Staff—2. daily. General surgical operations and clinical demonstrations.
WILLIAM ADAMS. Demonstrations in thoracic surgery
EDMUND ANDREWS. Gall-bladder surgery
ALEXANDER BRUNSCHWIG. Management of malignant tumors and experimental bone tumors.
E. L. COMPER, C. H. HATCHER and DR. MEYER. Operations and demonstrations in orthopedic surgery
LESTER R. DRAGSTEDT. Surgery of the stomach and colon
C. B. HUGHES and H. E. HAYMOND. Operations and demonstrations in genito-urinary surgery
HILGER P. JENKINS. Abdominal surgery
D. B. PHILIPSTER. Bone surgery operations and demonstrations.

PASSAVANT MEMORIAL HOSPITAL—NORTH
WESTERN UNIVERSITY MEDICAL SCHOOL

Tuesday

LEANDER W. RIERA—9. The use of the electro-urethrotome in urethral strictures.

ARTHUR H. COVERTS and GEORGE H. GARDNER—9. Gynecological operations.

JOHN A. WOLFE—9. Cholecystitis, carcinoma of colon.

JACOB R. BUCHENBERGER—9. Thyroid surgery.

JOHN S. COULTER—10. Physical therapy.

RUDOLPH W. HOLMES and staff—2. Symposium on cardiac diseases in their obstetric associations. CHAUNCEY C. MANN: Etiology and pathology. JAMES E. FITZGERALD: Medical aspects and treatment. JAMES H. BLOOMFIELD: Obstetrical aspects and treatment.

PAUL B. MACARTHUR—2. Ununited fracture of the neck of the femur: bone graft to the spine.

JOHN A. WOLFE—2. Dry clinic. Abrogation of the critically ill patient by jejunal feedings.

LOYAL DAVIS, LEWIS J. POLLOCK, HALE HAVEN and DAVID A. CLEVELAND—2. Symposium on neurologic surgery.

Wednesday

HARRY M. RICHTER—9. Thyroid surgery.

LOYAL DAVIS—9. Neurologic surgery.

SCHORER L. KOCH and MICHAEL L. MARSH—9. Nerve and tendon surgery of the hand.

JAMES T. CASE—9. Roentgenology.

PHILIP H. KREUSCHER—2. Hip joint surgery.

ALLEN B. KAMAYEL, SCHORER L. KOCH and M. L. MARSH—2. Review of twenty years of surgery of the hand.

RUDOLPH W. HOLMES and staff—2. Symposium on toxic lesions of late pregnancy: renal and hepatic. JAMES P. SHERMAN: Etiology and pathology. CHAUNCEY C. DOWD: Symptoms and laboratory investigation. DAVID S. HILLIS: Medical (expectant) treatment. RUDOLPH W. HOLMES: Obstetrical treatment.

LEANDER W. RIERA—2. Dry clinic. Prostatic resection.

EMIL D. W. HAUSER—2. Orthopedic surgery.

Thursday

ARTHUR H. COVERTS and GEORGE H. GARDNER—9. Gynecological operations.

JOHN A. WOLFE—9. Cholecystitis, carcinoma of the breast.

JACOB R. BUCHENBERGER—9. Abdominal surgery.

JOHN S. COULTER—9. Physical therapy.

PHILIP H. KREUSCHER—2. Shoulder and knee joint disengagement.

RUDOLPH W. HOLMES and staff—2. Symposium on obstetrical hemorrhages. RUDOLPH W. HOLMES: Abnormal placentas. DAVID S. HILLIS: Placenta previa. MAGNUS P. URSIN: Postpartum hemorrhages. THEODORE W. BLANCHARD: Treatment of sequential eclampsias.

CHARLES A. ELLIOTT, WALTER H. NADLER, PAUL STARR, M. HERBERT BARKER, HOWARD B. CARROLL and HOWARD L. ALT—2. Symposium on hepatic diseases.

Friday

HARRY M. RICHTER—9. Gastric surgery.

LOYAL DAVIS—9. Neurologic surgery.

SCHORER L. KOCH and MICHAEL L. MARSH—9. Irradiation ulcers of the hand, Dupuytren's contracture.

JAMES T. CASE—9. Roentgenology.

PAUL B. MACARTHUR—2. Demonstration of principles for overcoming deformity in ununited fractures before operation, bone grafts for ununited fractures.

RUDOLPH W. HOLMES and staff—2. Symposium on hyperemesis gravis. CHAUNCEY C. DOWD: Etiology and pathology. MAGNUS P. URSIN: Symptoms and clinical course. JAMES H. BLOOMFIELD: Treatment.

HARRY M. RICHTER, ARTHUR C. IVY, SAMUEL J. FOGELSON and A. J. ATKINSON—2. Symposium on gastric ulcer.

ST. LUKE'S HOSPITAL

Monday

H. E. MOCK, A. REID MORROW and CHARLES SEARSON—2. General surgical operations.

E. OLSEN—2. Neurological surgery.

Tuesday

H. O. JONES, WILLIAM P. CARLHILL, M. J. KILEY, E. A. EDWARDS and JOHN BREWER—9. Gynecological operations: early human embryo demonstration.

CARL HEDBLÖM and WILLARD VAN HATEL—9. Thoracic surgery.

H. E. MOCK—2. Reconstructive surgery.

L. L. MCARTHUR and S. W. MCARTHUR—2. General surgery.

Wednesday

L. E. SCHMIDT—9. Urological clinic.

E. W. RYERSON and F. A. CHANDLER—9. Orthopedic operations.

S. C. PLENNER—9. General surgery.

H. E. JONES and T. L. HANSEN—9. General surgery.

E. W. RYERSON, R. O. RITTER and H. O. SORRELL—2. Orthopedic operations.

FRANK E. DAVID, C. J. DEBIRE and G. A. POWERS—2. Rectal surgery.

Thursday

G. DE TARANT—9. Surgery in juvenile diabetes, ambulatory vein ligation of varicose veins.

H. E. MOCK—9. General surgery.

HARRY CULVER—9. Urological clinic.

H. E. MOCK, A. REID MORROW and CHARLES SEARSON—2. Skull fractures.

W. R. COVINGS—2. General surgery.

H. B. THOMAS and F. W. HAAS—2. Orthopedic clinic.

Friday

W. F. LYON—9. Dislocations of the shoulder with fracture of the greater trochanter.

H. POTTS and F. W. MERRIFIELD—9. Oral surgery operative.

E. W. RYERSON, F. A. CHANDLER and R. O. RITTER—2. Orthopedic clinic.

HOSPITAL OF ST. ANTHONY DE PADUA

Monday

THOMAS DWYER—2. Demonstrations in surgical pathology.

Tuesday

LAWRENCE RYAN—9. General surgery.

J. J. SPALANCA—9. General surgery.

O. J. JIRKA—9. Urology.

L. S. TIGHT—2. X-ray demonstration.

Wednesday

R. C. COPLER—9. General surgery.

JOSEPH ZABOZETSKY—9. General surgery.

F. W. SLOAN—2. Fracture clinic.

M. A. WEINBERG—2. Obstetrics.

Thursday

FRANK J. JIRKA—9. Abdominal operations.

F. B. OLSEN and E. C. DEURY—9. Thyroid surgery and general surgical clinic.

O. J. JIRKA—9. Urology.

L. S. TIGHT—2. X-ray demonstration.

Friday

S. E. DOUGLASS—9. General surgery.

A. A. BONA—9. General surgery.

M. A. WEINBERG—9. Obstetrics.

MOUNT SINAI HOSPITAL

Tuesday

- V. L. SCHLAGER and J. T. GAULT—9. Hernia, breast and biliary surgery
ISRAEL DAVIDSOHN—11. Pathological demonstration.
M. I. KAPLAN—11. X ray diagnosis and therapy
GUSTAV KOLDSCHER and HARRY ROLNICK—2. Genito-urinary surgery

Wednesday

- HARRY M. RICHTER, J. M. MORA and D. WILLIS—9. Gastric and thyroid surgery
ISRAEL DAVIDSOHN—11. Pathological demonstration.
M. I. KAPLAN—11. X ray diagnosis and therapy
ALFRED A. STRAUSS, S. STRAUSS, E. GREENE, L. E. BISHKOW and B. SAYRE—2. Gastro-intestinal surgery
RALPH B. BITTMAN and L. HANDELMAN—2. Intrathoracic surgery operations.

Thursday

- AARON KAMTER, A. F. LASH, E. SCHWED and H. L. KLAUWANS—9. Gynecological operations.
ISRAEL DAVIDSOHN—11. Pathological demonstration.
M. I. KAPLAN—11. X ray diagnosis and therapy
CHARLES JACOBS and LEO MULLER—2. Orthopedic operations.

Friday

- HARRY ROLNICK—9. Genito-urinary surgery
ISRAEL DAVIDSOHN—11. Pathological demonstration.
M. I. KAPLAN—11. X-ray diagnosis and therapy

Dry Clinics—Daily 9 and 3

- ISRAEL DAVIDSOHN. Value of biopsy in surgery
HENRY BUCKBAUM. Toxicosis of pregnancy
GUSTAV KOLDSCHER—Electrosurgery in cancer therapy
AARON KAMTER. Chorio-epithelioma following a vesicular mole. functional uterine hemorrhage.
HARRY ROLNICK. Bladder tumors
A. F. LASH. Treatment of birth injury. early diagnosis of uterine cancer
DAVID A. WILLIS. Relation of adrenals to thyrotoxicosis morbidity in operation for acute appendicitis in relation to the question of drainage. demonstration of a universal traction splint as used in a small hospital.
LEO L. ASHOF. Fractures of the maxilla and mandible.
M. REBER GUTTMAN. Recent advances in the treatment of malignant diseases about the head and neck. endoscopic clinic.
Staff Symposium. Cancer of the lung. I. M. TRACE, medical aspect. JACOB LIRSCHUTZ, bronchoscopic aspect. ISRAEL DAVIDSOHN, pathological aspect. M. I. KAPLAN. X ray aspect.
MARGARET LEWISON. Medical appraisal of surgical risks.
JOSEPH T. GAULT. Present status of the treatment of varicose veins.
EARL I. GREENE. Intestinal obstruction
J. M. MORA. Inflammatory lesions of the thyroid
I. E. BISHKOW. Present status of blood transfusion.

ST FRANCIS HOSPITAL

Thursday

- T. FOWLER—2. Painful shoulder
H. RALPH—2. Indications for duodenal and jejunal drainage and feeding
T. E. CONLEY—2. Value of hyperventilation prevention and treatment of thrombophlebitis.
B. FULLIS—2. Mechanical aids in urology
H. F. MARY—2. Uses and improved methods of administration of parenteral fluids
I. H. CHILCOTE—2. Management of gastric, biliary and jejunal fistula.

ST MARY OF NAZARETH HOSPITAL

Monday

- A. S. SAMPOLINSKI—2. General surgical clinic.
E. H. WARSZEWSKI and P. F. CZWALINSKI—2. Inguinal hernia clinic.
THAD LARKOWSKI—2. Demonstration of blood transfusion

Tuesday

- GEORGE MUELLER—9. General surgical clinic.
S. R. PIETROWICZ—9. Spinal puncture and anesthesia—indications, contra-indications, advantages, disadvantages. demonstrations.
C. C. HUCZYNSKI—2. Varicocele operations and demonstrations.
M. J. BADZIMKOWSKI and B. PIETRYNICKI—2. Colic clinic, operations and demonstration of cases.

Wednesday

- T. Z. XELOWSKI—9. Gynecology and abdominal surgery
W. A. KUTYLINSKI—9. Emergency and general surgery
THOMAS PLANT—9. General surgery
A. A. THIEDA—9. General surgery
FRANK TENZAR—9. General surgery
JOHN TENZAR—9. General surgery
CHESTER CHALLENGER—9. X ray demonstration.
MICHAEL KUTZA—3. General surgery
F. A. MACKOWIAK—3. General surgery
M. E. UZANICKI—2. Obstetrical clinic, low cesarean section.
M. KRUTENIK—2. Removal of pilonidal cyst.

Thursday

- LEO CRAJA—9. Orthopedic clinic. maggot treatment of osteomyelitis.
E. MACDONALD—9. Abdominal surgery
H. H. HILL—9. Demonstration of pathological specimens.
A. V. PARTIHELLO—2. Aseptic resection of the bowel, demonstration of cases, moving picture exhibition.
M. E. UZANICKI—2. Surgical anatomy of the perineum, lantern slide demonstration.

Friday

- JOSEPH WELFELD—9. Urological clinic.
GEORGE MUELLER—9. General surgery
CHESTER CHALLENGER—9. X ray demonstration
H. H. HILL—9. Demonstration of pathological specimens.
ROBERT E. FLANNERY—3. Gall-bladder surgery
LEO P. KOSAKIEWICZ—3. Cesarean section indications, contra indications. demonstrations

GRANT HOSPITAL

Tuesday

- ANDRE L. STAPLER—9. General surgery
F. H. FALLS—9. Gynecology
P. FISCHMANN—9. Vaginal hysterectomy
A. G. FREY—9. General surgery
GEORGE ABELLO—9. General surgery
E. HERR—10. Urology

Wednesday

- E. STIDLER—9. Midline resection.
A. G. ZIMMERMAN—9. General surgery

Thursday

- B. H. OXENOFF—9. Electrosurgery
W. A. STURK—9. General surgery
ANDRE L. STAPLER—2. General surgery

Friday

- SYLVAN COOMBS—9. General surgery
E. W. FISCHMANN—9. Pus tubes.
A. G. ZIMMERMAN—9. General surgery

MICHAEL REISE HOSPITAL

Tuesday

ALFRED A. STRAUSS, SEIGFRIED F. STRAUSS, JAMES PATEDJL and ROBERT A. CRAWFORD. Stomach resections for gastric and duodenal ulcer; common duct duodenal anastomosis and gastro-enterostomy for chronic obstructive jaundice.

GEORGE L. DAVENPORT and RALPH BETTMAN. Gall-bladder surgery; surgery of the common duct.

D. C. STRAUSS. Thyroid surgery.

E. FRIEDL. General surgery; surgery of the gall bladder.

BERNARD PORTER. Thyroid surgery; surgery of the rectum.

HARRY RUCHTER. Thyroid surgery; gall-bladder surgery.

MAX CUTLER. Surgery of the breast.

GUSTAV KOLBACHER. Diathermy of bladder tumor; nephrectomy for tuberculous.

IRVING KOLL. Electrical resection of prostate; nephro-lithotomy.

DANIEL H. LEVINTHAL. Internal derangements of the knee joint, removal of semi-lunar cartilage; synovectomy for chronic arthritis, bone lengthening operation.

JULIUS E. LACKNER. Abdominal hysterectomy; interposition operation; rectovaginal fistula.

JOSEPH L. BAER and RALPH REIS. Complete perineal incision, ovarian tumor and pelvic inflammation.

Wednesday

D. C. STRAUSS. Thyroid surgery; gall-bladder surgery.

RALPH BETTMAN. Surgery of the chest.

GEORGE L. DAVENPORT. General surgery.

ALFRED A. STRAUSS, SEIGFRIED F. STRAUSS and ROBERT A. CRAWFORD. Sectional colectomy for ulcerative colitis and pyloroplasty for congenital pyloric stenosis.

BERNARD PORTER. General surgery and surgery of the colon.

MORRIS L. PARKER. General surgery.

JAMES PATEDJL. General surgery.

JOSEPH EISENSTADT. Undescended testis; suprapubic prostatectomy.

HARRY RUCHTER. Electric resection of prostate; pyelotomy for stones.

PHILIP LEWIN and SIMON SEIDMAN. Orthopedic clinic, shoulder, elbow, hand, hip, pelvis.

L. E. FRANKENTHAL, Sr. and L. E. FRANKENTHAL, Jr. Gynecological operations.

W. H. RUBINSTEIN. Obstetrical and gynecological clinic, demonstration of forceps, craniotomies and complete suture, episiotomy.

IRVING STEIN and M. L. LEVINTHAL. Obstetrical clinic, low cervical cesarean under local anesthesia.

Thursday

RALPH BETTMAN. Surgery of gall bladder and common duct.

ALFRED A. STRAUSS, SEIGFRIED F. STRAUSS and ROBERT A. CRAWFORD. Surgical diathermy for carcinoma of the rectum; resections for carcinoma of the stomach.

D. C. STRAUSS. Surgery of colon, small intestine, thyroid.

GEORGE L. DAVENPORT. Surgery of the common duct.

BERNARD PORTER. General surgery.

SEIGFRIED F. STRAUSS. General surgery.

HARRY RUCHTER. Surgery of the thyroid.

E. FRIEDL. Surgery of the gall bladder and common duct.

ALFRED C. JONES. Nephrectomy for tuberculous kidney; suprapubic prostatectomy.

IRVING SHAFER. Diathermy of bladder tumor; nephrectomy for tumor of kidney.

DANIEL H. LEVINTHAL. Surgery of the spine, fusion operation for scoliosis and for tuberculous.

CHARLES M. JACOB. Orthopedic clinic.

JULIUS E. LACKNER. Gynecological operations.

JOSEPH L. BAER and RALPH REIS. Prolapse; vaginal hysterectomy; fibroids; occiput posterior.

Friday

ALFRED A. STRAUSS, SEIGFRIED F. STRAUSS, JAMES PATEDJL and ROBERT A. CRAWFORD. Subtotal gastrectomy for gastrojejunal ulcer; resection of colon for carcinoma.

D. C. STRAUSS. Surgery of the thyroid and general surgery.

GEORGE L. DAVENPORT and RALPH BETTMAN. Gall-bladder surgery and surgery of the common duct.

RALPH BETTMAN. Thoracic surgery.

BERNARD PORTER. Surgery of the colon and rectum.

MORRIS L. PARKER. General surgery.

MAX CUTLER. Surgery of the breast; use of radiotherapy in carcinoma.

FREDERICK LICHTENTHAL. Suprapubic prostatectomy; ureterotomy.

J. S. GROVE. Undescended testes.

PHILIP LEWIN and SIMON SEIDMAN. Orthopedic clinic, back, hip, knee, foot, shoulder; demonstration of arthritis cases.

L. E. FRANKENTHAL, Sr. and L. E. FRANKENTHAL, Jr. Gynecological clinic.

W. H. RUBINSTEIN. Gynecological clinic.

IRVING STEIN and M. L. LEVINTHAL. Gynecological clinic.

WOMEN AND CHILDREN'S HOSPITAL

Monday

FRANCIS FORD—2. X-ray therapy in malignancies.

Tuesday

BERNHA VAN HOOSEN—9. Gynecological operations.

JOSEPHINE MCCOLLUM and BERNHA VAN HOOSEN—10. Demonstrations of morphine and scopolamine anesthesia in surgery.

O. ZELENTY—11. Demonstrations of electrocoagulation therapy.

Wednesday

PEARLE STETLER—9. General surgical operations.

WALBURGA KACIN and CLARA COHEN—2. Obstetrical cases, management under scopolamine anesthesia.

FRANCIS FORD—2. X-ray demonstrations.

PEARLE STETLER—2. Surgical diagnosis of appendicitis in children.

Thursday

ALICE CONKLYN—9. General surgery.

Staff—9. Fracture cases.

MARIE OENTMAYER—10. Urological clinic.

AMELIA GRYTOVAS—11. Carcinoma of the pelvis.

ELOISE PARSONS—2. Endocrine therapy in gynecology; sterility operations.

Friday

MARY E. WILLIAMS—9. Gynecological operations.

CONSTANCE O'BRIEN—11. General surgical operations.

MARY SPYACK and FLORENCE HARK—2. Obstetrics.

CHARLES FORD—2. X-ray and diathermy therapy.

SHIRINERS' HOSPITAL

Tuesday

BEVERIDGE MOORE and HAROLD SORTFELD—9. Orthopedic operations.

Wednesday

BEVERIDGE MOORE—2. Demonstration of plaster technique; club foot clinic.

Thursday

BEVERIDGE MOORE and HAROLD SORTFELD—9. Orthopedic operations.

Friday

BEVERIDGE MOORE and HAROLD SORTFELD—2. Out-patient clinic.

PRESBYTERIAN HOSPITAL AND RUSH
MEDICAL COLLEGE

Tuesday

- A. D. BEVAN—9. Surgery of the breast.
V. C. DAVID—9. Carcinoma of sigmoid.
H. L. KRETSCHMER—9. Kidney surgery.
R. H. HEARST—9. Transurethral electro resection of prostate gland.

KELLOGG SPEED—9. Tumors of chest wall, demonstration of cases, lantern slides.

- A. H. MOOREHEAD—11. Abdominal surgery in children.
A. VERBRUGGEN—3. Neurosurgical operation.

Wednesday

- A. D. BEVAN—9. Hernia and undescended testicle.
F. B. MOOREHEAD—9. Plastic surgery of mouth and face.
C. B. DAVID—9. Tumors of the large intestine.
H. L. KRETSCHMER—9. Surgery of the bladder.
N. S. HEARST—9. Vaginal surgery.
DR. GATEWOOD—10. Carcinoma of the stomach follow-up clinic.

- E. M. MILLER—10. Thyroid surgery.
H. A. OVERHELMAN—10. Surgery in diabetic patients.
E. R. MCCARTHY—11. Strangulated hernia in infants.
W. J. POTTS—12. Fracture problems.

Thursday

- A. D. BEVAN—9. Surgery of gall bladder and bile tract.
H. L. KRETSCHMER—9. Transurethral resection of the prostate.

T. B. MOOREHEAD—9. Cleft palate surgery: operative treatment of ankylosis of jaw.

- DR. GATEWOOD—9. Gastric resection for ulcer.
R. H. HEARST—9. Diverticula of urinary bladder.
R. H. HEARST and C. W. APPELBAUGH—9. Unusual urinary anomalies.

Staff—9. Dry clinic. E. D. ALLEN endometriosis, C. P. BAKER dyslexia. AARON KANTZ, recognition of early carcinoma of uterus.

G. L. McWHORTER—10. Fracture of the greater tuberosity of the humerus.

A. VERBRUGGEN—10. Spinal cord injuries.

Friday

- Staff—9. Dry clinic. A. D. BEVAN. Present status of anesthesia. H. L. KRETSCHMER. Genito-urinary surgery. R. C. BROWN. Treatment of massive hemorrhage in gastric ulcer. V. C. DAVID. Significance of polyps of large bowel. F. M. MILLER. Method of intravenous injection over long period of time. R. H. HEARST. Fluorids of bladder neck. F. H. STRAUSS. Obstructive jaundice. G. L. McWHORTER. Reconstruction of common bile duct cases. M. L. LOHRER. Gonorrhea inguinalis, cases. S. E. LAWTON. Cholecystenterostomy indications.

E. J. BECKHEUSER—3. Orthopedic clinic.

SOUTH CHICAGO COMMUNITY HOSPITAL

Tuesday

M. E. FOXLEY—2. Avertin anesthesia, analysis of 200 cases.

LOUIS D. SMITH—2 30. Tuberculosis of the kidney presentation of case.

Friday

JOSEPH J. LEBOWITZ—3. Fractures and dislocations of the elbow presentation of cases treated by open operation.

FRANK G. MORPHY—2 30. Fractures of the upper end of the humerus, presentation of cases.

GEORGE G. O'BRIEN—3. Postoperative eversion presentation of case.

INSTITUTE OF TRAUMATIC SURGERY

(St. Luke's Hospital)

Monday

- GEORGE G. DAVIS—9. Rupture of the urethra.
JOHN D. ELLIS—9 15. Routine examination of injured back.

FREMONT A. CRANDLER—9 30. Separation of isthmus of lower lumbar vertebrae.

WILLIAM R. CURRAN—9 45. Old dislocation of shoulder.

HARRY E. MOCK—10. Demonstration of cases of multiple injury.

LEROY P. KUTER—10 15. Ruptured spleen and other abdominal cases.

E. W. RYDERSON—10 30. Spondylolisthesis in relation to injuries.

GEORGE L. APPELBAUGH—10 45. Cotton's fracture.

R. W. McNEALY—11. Immediate repair of injured blood vessels.

E. C. HOLMELAND—11 15. Compression fractures of the spine.

PHILIP H. KRETSCHMER—11 30. Knee joint injuries.

HOLLIS E. POTTER—11 45. Some X-ray aspects of silicosis.

C. R. G. FORRESTER—12. Reduction of fractures under local anesthesia together with ambulatory treatment, moving picture demonstration.

LEROY THOMPSON—1 30. Intra-ocular foreign bodies.

STONEY WALKER, JR.—1 45. Lacerated wounds of the eyeball.

PAUL B. MAGNUSON—2. Anomalies of the spine.

A. M. HARVEY—2 15. Demonstration of rehabilitated cases.

EDSON B. FOWLER—2 30. Troublesome shoulders.

KELLOGG SPEED—2 45. Injuries to internal acromioclavicular cartilage.

HERMAN L. KRETSCHMER—3. Management of traumatized kidney.

JAMES A. VALENTINE—3 15. Treatment of ruptured biceps tendon.

FRED M. MILLER—3 30. The injured hand.

STONEY B. MACLEOD—3 45. New apparatus to increase efficiency of Thomas splint.

FRED W. SLOSKA—4. Bilateral renal carbuncle with perinephritic abscess.

HART E. FISHER—4 15. Electric burns in children.

CLARENCE W. HOPKINS—4 30. Modern treatment of compression fractures of the spine.

ARNO B. LUCKENBART—4 45. Choice of anesthetic in surgical shock.

WESLEY MEMORIAL HOSPITAL

Monday

P. B. MAGNUSON—3. Bone surgery.

Tuesday

R. W. McNEALY—9. Gall-bladder surgery gastro-intestinal surgery.

C. B. REED—3. Obstetrical clinic moving picture demonstration of breech delivery, perineorrhaphy and for cephalopelvic demonstration of external measurements of intra-uterine child.

Wednesday

PHILIP H. KRETSCHMER—9. Joint surgery.

GUY VAN ALSTON—9. Osteitis tuberculosa multiplex cystica (Judding).

G. H. GARDNER—9. Gynecological clinic.

Thursday

M. T. GOLDSTEIN—9. Gynecological clinic, vaginal plastic work.

MUNICIPAL TUBERCULOSIS SANITARIUM

Tuesday

- CLARENCE L. MARTIN—9. Peritoneal tuberculosis
 MICHAEL JOHANNES—9. Thoracoplasty; phrenic neurectomy
 HENRY C. SWIRLEY—11. Pathological conference, demonstration of pathological specimens.

Wednesday

- DORRIS F. RUDICK—9. Nephrectomy for tuberculosis of kidney; operative surgery for tuberculosis of the genitourinary tract
 FRANK FREEMAN and FRANK SIEGEL—9. Artificial pneumothorax
 FREDERICK TICE, ALLAN J. HEURY and K. J. HIRSCHBERG—9. Diagnostic clinic.

Thursday

- MICHAEL JOHANNES and RICHARD DAVIDSON—9. Thoracoplasty; pneumothorax, phrenic neurectomy
 K. J. HIRSCHBERG—9. Artificial pneumothorax.

Friday

- ALLAN J. HEURY and K. J. HIRSCHBERG—9. Surgical conference

OUTPATIENT PNEUMOTHORAX CLINIC

3049 Washington Boulevard

- MICHAEL JOHANNES, E. L. QUINN, EMIL BUNTA, CLARA JACOBSON and GEORGE TROGLOO—9 and daily
 Artificial pneumothorax on ambulatory patients.

CHICAGO LYING-IN HOSPITAL

- STAFF: FRED L. ADAMS, J. B. DELLE, WILLIAM J. DYCK, MARK M. EDWARDS, D. VAN, FRANK F. WEITZEL, MANUEL SPIEGEL and H. C. HENNINGSEN

Monday

- Staff—2. Obstetrical operations, motion picture demonstration

Tuesday

- Staff—9. Obstetrical and gynecological operations

Wednesday

- Staff—9. Obstetrical and gynecological operations.
 Staff—3. Obstetrical clinic, motion picture demonstration.

Thursday

- Staff—9. Obstetrical and gynecological operations
 Staff—2. Obstetrical and gynecological dry clinic, motion picture demonstration

Friday

- Staff—9. Obstetrical and gynecological operations.
 Staff—2. Obstetrical and gynecological dry clinic, motion picture demonstration

WASHINGTON BOULEVARD HOSPITAL

Tuesday

- PAUL C. FOX—9. Gynecological clinic.

Wednesday

- A. R. MITE—9. General surgical clinic, presentation of unusual fractures.

Thursday

- V. J. O'CONNOR—9. Hydrosophrosis, etiology and treatment, case reports, X-rays and operative results; suprapubic prostatectomy and transurethral resection of prostate; comparative indications and results

RAVENSWOOD HOSPITAL

Tuesday

- G. W. GREEN—9. Gall-bladder surgery; mortality and morbidity
 C. A. BURNELL—9:30. Survey of cadet study organization in a private hospital
 D. B. POWE—10. Orthopedic surgery
 E. W. MITCHELL and J. J. MOORE—10:30. Carcinoma of testis.
 M. FIELD—11. Diagnosis and management of sterility
 L. C. FREDRICK and D. L. JACOBSON—1:30. Gastric syphilis.

Wednesday

- G. DE TARNOWSKY and J. J. MOORE—9. Carcinoma of colon, modified Kraske operation.
 J. IRELAND—9:30. Fractures of the elbow
 K. F. WEISSBRODTER—10. Emotions as etiological factors in hyperthyroidism.
 C. H. LOCKWOOD—10:15. Headaches.
 H. P. SANDERS—11. Blood transfusion.
 L. E. DAY—11:15. Obstetrics.
 J. F. OATES—11:30. Spinal anesthesia.

Thursday

- C. C. RENTRO—9. Obstetrical anesthesia.
 W. F. GROSVENOR—9:15. Cesarean section.
 A. C. HAMMETT—9:30. Mental disturbances of diabetes.
 A. V. BERNQUIST—9:45. Indigestion.
 F. N. BERRY—10. Granulosa cell carcinoma of ovary
 R. F. DYER—10:30. Surgical technique
 P. J. SARMA—11. Paramedian abdominal incision.
 F. R. VON MAMOWSKI—11:15. Mortality in appendicitis.
 E. B. WILLIAMS—1:30. Pott's disease; fracture of spine.

OAK PARK HOSPITAL

Tuesday

- JOHN W. TOPPE—9. General surgery
 GORDON SWANSON—9. Orthopedic clinic.
 ARTHUR CONLEY—9. Management of fractures of the femur

Wednesday

- RALPH SULLIVAN—9. General surgical clinic; treatment of peptic ulcer
 CHARLES FOX—9. Gynecological operations.
 CARL UTHOFF—9. Operative cystoscopy

Thursday

- LOUIS RIVER—9. General surgery
 ANDREW KRAFT—9. General surgery
 CARL UTHOFF—9. Genito-urinary operations.

Friday

- JOHN W. TOPPE—9. General surgery
 MEREDITH MURRAY—9. Gynecological operations.

FRANCES L. WILLARD HOSPITAL

Tuesday

- ALLEN E. STEWART and MILTON OCHS—9. General surgical clinic.
 FREDERICK MUELLER—3. Surgery of bones and joints.

Wednesday

- OTIS M. WALTER—9. General surgical clinic.
 VAUGHN L. SHERMAN—10. Diabetic clinic.

Thursday

- JOSEPH F. JAMES—9. Thyroid clinic.

Friday

- VICTOR L. SCHLAGER—9. General surgical clinic.

MERCY HOSPITAL

Tuesday

- E. M. BROWN—9. Malignancy of the colon.
J. E. KELLY—9. Chronic intestinal fistula extensive ventral hernia.
GEORGE GRIFFIN—9. Pyloric obstruction.
J. D. CLARIDGE—9. Fractures and dislocations of the cervical spine.
C. J. LARSEN—9. Rupture of the spleen simulating acute appendicitis.

Wednesday

- M. F. MCGUIRE—9. Biliary tract surgery.
C. F. SAWYER—9. Acute pancreatitis perforating gastric and duodenal ulcers.
C. L. MARTIN—9. Anal fistulectomies in cases with pulmonary tuberculosis.
L. E. GARRISON—9. Carcinoma of the colon carcinoma of the breast.
HERBERT E. LANDES—9. Surgical anatomy of vesical orifice and urethral obstructions treatment of bladder tumors.

Thursday

- L. D. MOOREHEAD—9. Toxic goiters, differential diagnosis of cases of dysthyroidism and hyperthyroidism with indication for operation and management.
W. J. PICKETT—9. Technical considerations in posterior gastro-enterostomy.
F. E. PIERCE—9. Fracture cases.
F. M. DREKOW and F. C. VALDEZ—9. Gastro-intestinal clinic.

Friday

- HENRY SCHMIDT and HERBERT E. SCHMIDT—9. Gynecological clinic surgery and radiation therapy.
JOSEPH LAUBE—9. Carcinoma of the genito-urinary tract.
A. M. VAUGHN—9. Cystic hygroma in an infant.

COLUMBUS HOSPITAL

Tuesday

- DANIEL A. ORTH, C. O. LINDSTROM and M. L. HANMAN—9. General surgery.
DANIEL A. ORTH—9. Indications and contra indications for spinal anesthesia.
CHANNING BARRETT—9. Gynecological operations.
MINUS JOUKNIDES—9. Collapse therapy in pulmonary tuberculosis.

- M. J. SEIFERT—10. Surgical treatment of ulcer of the stomach.
MINUS JOUKNIDES—2. Surgery of the chest.

Wednesday

- CHANNING BARRETT—9. Gynecological clinic.
G. V. BELCHER and M. B. BURKS—9. Emergency surgery in industrial injuries.

Thursday

- MINUS JOUKNIDES—9. Surgical treatment of abscess of lung.
F. MUELLER and F. MUELLER, JR.—9. Transplantation of bone.
WILLIAM GRIEL and T. L. CHENOWETH—9. Urological clinic.
G. V. BELCHER and M. B. BURKS—9. Emergency surgery in industrial injuries.

Friday

- DANIEL A. ORTH, C. O. LINDSTROM and M. L. HANMAN—9. General surgery.
M. J. SEIFERT—9. General surgery.

JACKSON PARK HOSPITAL

Monday

- F. L. BARBOUR—2. Dry clinic. Symposium on treatment of pulmonary tuberculosis, surgical and medical.

Tuesday

- T. H. KELLEY—9. General surgical clinic.
ARRIE BAMBERGER—10. General surgical clinic.
C. C. CLARK—11. General surgical clinic.
S. B. MACLEOD—2. Fracture clinic.

Wednesday

- ARRIE BAMBERGER—9. General surgical clinic.
H. HOYT COX—10. General surgical clinic.
S. W. MARCHEMONT ROBINSON—2. Dry clinic. Hand infections as related to industrial surgery.
H. F. SPERLING—3. Mortality of appendicitis.

Thursday

- ARRIE BAMBERGER—9. General surgical clinic.
T. H. KELLEY—10. General surgical clinic.
G. MARCHEMONT ROBINSON—11. Injection treatment of hemorrhoids.
E. ALLEN PARSONS—12. Postoperative treatment of ruptured appendix with peritonitis.
R. T. FARLEY—1. Chorio-epithelioma pseudo Addison's disease vulvula.
J. J. MOORE—2. Gross surgical pathology.

Friday

- A. F. HENNING—9. General surgical clinic.
GEORGE M. LUCAS—10. Gynecological surgery.
C. C. CLARK—11. General surgical clinic.

SOUTH SHORE HOSPITAL

Tuesday

- AXEL WERELIUS—9. Gastric surgery.
GEORGE G. O'BRIEN—11. General surgery.
CLARENCE S. DUNER and AXEL WERELIUS—2. Symposium on gastric and duodenal ulcer.

Wednesday

- HUGH MACKECHNIE—9. Surgery of the colon.
FRANK G. MURPHY—11. Orthopedic clinic.
H. WILLIAM ELOHARMER, GUY S. VAM ALSTYKE and PAUL R. CANVON—2. Symposium on intussusception.

Thursday

- LOUIS D. SMITH—9. Genito-urinary surgery.
CLARA JACOBSON—2. Lung collapse procedures.
C. C. MAIER—3. Cardiac risk in surgery.

Friday

- E. A. LUTTON—9. Gynecological clinic.
ANDREW DAHLBERG and WILLIAM HANRAHAN—11. Operative obstetrics.
H. R. COLVER—2. Industrial surgery.
WALTER FISCHER—3. Foot problems.

EVANGELICAL DEACONESS HOSPITAL

Tuesday

- EDWARD HEACOCK—9. General surgery.

Wednesday

- PAUL MORR—9. General surgery.

Thursday

- A. J. SCHOENBERG—9. Pelvic surgery.

Friday

- JOHN PEARL—9. Abdominal surgery—spinal anesthesia.

EVANSTON HOSPITAL

Tuesday

JAMES T. CASE—*o*. X-ray diagnosis and therapy
 WILLIAM R. PARKER—*o*. Thyroid clinic.
 MARCUS H. HOWART—*o*. General surgical clinic
 DWIGHT F. CLARK—*o*. Recent advances in the treatment
 of common fractures.
 MARCUS H. HOWART—*o*. Fracture clinic

Wednesday

WILLIAM C. DANFORTH—*o*. Gynecological operations.
 CHARLES E. GALLOWAY—*o*. Gynecological operations
 JEROME R. HEAD—*o*. Thoracic surgery
 FREDERICK CHRISTOPHER—*o*. Demonstration of surgical
 cases
 ROBERT C. LOWENBERG—*o*. Demonstration of orthopedic
 cases.

Thursday

WILLIAM C. DANFORTH—*o*. Gynecological operations
 JOHN L. PORTER—*o*. Orthopedic operations
 WILLIAM C. DANFORTH—*o*. Obstetrical clinic
 CHARLES E. GALLOWAY—*o*. Schiller test for the early
 diagnosis of carcinoma of the cervix

Friday

FREDERICK CHRISTOPHER—*o*. General surgical clinic
 FRANK D. GUNN—*o*. Demonstration of surgical pathology
 CHARLES E. POPK—*o*. Proctological clinic
 J. F. ERITT SAWYER—*o*. Urological clinic

AUGUSTANA HOSPITAL

Tuesday

N. M. PERCY and O. E. NADREAU—*o*. Gout and general
 surgical clinic

Wednesday

A. T. LUNDGREN and EARL GARNER—*o*. General surgery
 J. W. NEZUM—*o*. General surgical clinic
 R. J. OLSEN—*o*. General surgical clinic

Thursday

N. M. PERCY and O. E. NADREAU—*o*. Gout and general
 surgical clinic

Friday

A. T. LUNDGREN and EARL GARNER—*o*. General surgery
 J. W. NEZUM—*o*. General surgical clinic
 R. J. OLSEN—*o*. General surgical clinic

LUTHERAN DEACONESS HOSPITAL

Tuesday

GEORGE H. SCHROEDER, JOHN KOOCKY, H. C. WALLACE
 and G. H. MAMMEN—*o*. General surgical clinic.

Wednesday

GEORGE H. SCHROEDER, JOHN KOOCKY, H. C. WALLACE,
 G. H. MAMMEN, R. G. WILLY and G. O. SOLER—*o*.
 Clinical demonstrations.

Thursday

GEORGE H. SCHROEDER, JOHN KOOCKY, H. C. WALLACE
 and G. H. MAMMEN—*o*. General surgical clinic.

Friday

GEORGE H. SCHROEDER, JOHN KOOCKY, H. C. WALLACE,
 G. H. MAMMEN, R. G. WILLY and G. O. SOLER—*o*.
 Clinical demonstrations.

ST BERNARD'S HOSPITAL

Monday

W. G. LARSEN—*o*. General surgery

Tuesday

W. J. MULHOLLAND—*o*. General surgery
 H. HOSKMAN—*o*. General surgery
 G. M. CUSHING—*o*. General surgery
 L. B. DODDLE—*o*. Genito-urinary surgery

Wednesday

B. C. CURRYWAY and R. J. MAIR—*o*. Roentgenological
 demonstration of anomalies of spine
 J. B. HANSEN—*o*. General surgery
 W. S. HARTON—*o*. General surgery
 J. A. PARKER—*o*. General surgery
 S. L. GOVERNORE and S. S. MARKER—*o*. Gastro-
 intestinal operations.

Thursday

J. T. MEYER—*o*. Thyroid surgery
 F. M. PEPPER—*o*. Genito-urinary surgery
 W. P. GUNN—*o*. Gynecological operations.
 D. A. VLOTDMAN—*o*. Gynecological operations
 C. C. GUY—*o*. Demonstration of unusual specimens

Friday

A. E. McCRADIE—*o*. General surgery
 E. A. RACH and F. J. STUCKER—*o*. Operative obstetrical
 problems

CHILDREN'S MEMORIAL HOSPITAL

Monday

FREDMONT A. CHANDLER, CHARLES V. PEASE and FERDINAND SEIDLER—*o*. Orthopedic clinic.

Tuesday

FREDMONT A. CHANDLER, FERDINAND SEIDLER and CHARLES
 N. PEASE—*o*. Orthopedic operations
 FREDERICK B. MOOREHEAD—*o*. Oral surgery operations
 and demonstration of cases.

Wednesday

ALBERT H. MONTGOMERY and staff—*o*. General surgery
 operations and demonstration of cases

Thursday

HERMAN L. KRETZSCHMER and staff—*o*. Urological surgery
 operations and demonstration of cases.

Friday

ALBERT H. MONTGOMERY and staff—*o*. General surgery
 operations and demonstration of cases.

ILLINOIS MASONIC HOSPITAL

Tuesday

E. WHITE—*o*. Prostatic surgery
 O. C. RITCH—*o*. Surgery of the kidney
 CLARENCE SAELEBY—*o*. Tumors of the testicle

Wednesday

GILBERT FITZPATRICK—*o*. Obstetrical problems
 CHARLES PARKER and J. R. HARRIS—*o*. Gall bladder
 problems.

CARL F. STEINBOCK—*o*. Medical consideration of thyroid
 disease.

HUGH MACKENZIE—*o*. Surgery of the thyroid.

Thursday

C. K. THOMAS—*o*. Surgical considerations of peptic ulcer
 J. F. DAVIS—*o*. Surgery of the colon.
 WALTER FRISCH—*o*. Orthopedic problems of the feet.

HOLY CROSS HOSPITAL

Tuesday

- J. FRANCIS RUZIC—9. Gynecological operations. cholecystectomy. high spinal anesthesia.
E. R. CROWDER—9. Some practical considerations regarding the Graham test.
JOHN F. DYBALSKI—10. Hysterectomy. spinal anesthesia.
VINCENT TORCZYNSKI—11. Appendectomy

Wednesday

- DONALD MONACO—9. Thyroidectomy. lecture on avertin anesthesia.
A. R. McCRAE—10. Hernia operation.
PAUL LAWLER—11. Low cervical cesarean section.

Thursday

- STEPHEN BRIGGS—9. Gynecological operations.
MICHAEL STEDOUT—10. Cholecystectomy
F. F. FRANDER—11. Panhysterectomy
C. H. McKENNA—11. Cholecystotomy

Friday

- M. J. BADZINSKI—9. Thyroidectomy. hysterectomy
RICHARD ROZIC—10. Hemiorrhaphy
ALEXANDER JAYOB—11. Appendectomy

JOHN B. MURPHY HOSPITAL

Monday

- JOSEPH KEREKES and R. J. MURPHY—2. Rectal treatment of appendical and other pelvic abscesses.

Tuesday

- H. E. DAVIS—10. Studies of epiphyseal growth disturbances.

Wednesday

- M. J. PURCELL—10. Emergency surgery
O. H. SCHULTZ—10. Observations on treatment of pneumonia.

Thursday

- F. O. BOWE—9. Treatment of postperal infections.
H. R. KERRY and S. J. MARK—10. General surgery

Friday

- A. C. GARVEY—10. Diagnosis and treatment of skull fractures.
H. R. KERRY and S. J. MARK—10. Pre-operative treatment in abdominal cases

POST-GRADUATE HOSPITAL

Monday

- B. C. CUSHWAY—2. X-ray diagnosis.

Tuesday

- H. SLOWAY—10. Urological clinic.
EMIL RIES—10. Gynecological operations.
D. SCHLAPPE—9. Intra-urethral prostatectomy. moving picture demonstration.

Wednesday

- J. C. BOODEL—10. Rectal operations.
LEO ZIMMERMAN—2. Phlebilia.

Thursday

- H. L. MEYERS—10. Gynecological operations.
R. A. LIPPENBERG—11. Gynecological clinic with colposcopic demonstration.

Friday

- LEO RIES—10. Gynecological operations.

RESEARCH AND EDUCATIONAL HOSPITAL

Monday

- H. B. THOMAS—1. Orthopedic surgery

Tuesday

- CARL A. HEDENLOM and WILLARD VAN HAZEL—9. Thoracic and general surgery
L. S. SCHULTZ—9. Oral surgery

Wednesday

- ERIC OLSSON—9. Neurological surgery
R. B. MALCOLM—9. Neurological surgery
H. B. THOMAS—1. Orthopedic surgery
F. H. FALLS—2. Obstetrical and gynecological clinic.

Thursday

- CHARLES B. PUGH—9. General surgery
C. M. McKENNA—10. Urological clinic. cystoscopy.
WILLARD VAN HAZEL—2. Thoracic surgery

Friday

- CARL A. HEDENLOM and WILLARD VAN HAZEL—9. Thoracic and general surgery
F. H. FALLS—2. Obstetrical and gynecological clinic

WEST SUBURBAN HOSPITAL

Monday

- HARRY J. DOOLEY—2. Urological clinic.

Tuesday

- WILLIAM J. POTTS—9. The healing of fractures.
OSCAR B. FUNKHOUSER—9. Gall-bladder surgery
THOMAS I. MOTTER—9. General surgery
JAMES H. SCILES—9. Gynecological clinic.

Wednesday

- JOSEPH L. NORTKELL—9. General surgery
FREDERICK H. FALLS—9. Gynecological clinic.

Thursday

- CHARLES E. HUNSTON—9. General surgery
WARD E. POTTER—9. Thyroid clinic.
LOUIS FAULKNER—9. Interesting obstetrical conditions.
PAUL C. FOX—9. Gynecological clinic.
EUGENE C. PIERRE—9. Pathological demonstration.
HOWARD HUNSTON—2. Urological clinic.

ST. JOSEPH HOSPITAL

Monday

- HUGH McKENNA—2. Review of traumatic surgery with special reference to fractures.

Tuesday

- FRANKLIN B. MCCARTY—9. Surgical anatomy pathology and surgical treatment of diseases of the gall bladder
RALPH A. KORZENAT—2. Breast tumors.

Wednesday

- HUGH McKENNA—9. Abdominal surgery. surgery of the large intestine.
WALTER W. VOTOT—9. Puerperal sepsis.
THOMAS J. O'DONOGHUE—2. Obstetrical and gynecological operations.

Thursday

- WILLIAM H. G. LOGAN—9. Cleft palate and cleft lip operations.
RALPH C. KORZENAT—2. Gall-bladder surgery

Friday

- L. WARD MARTIN—9. Obstetrical clinic.

ST ANNE'S HOSPITAL

Tuesday

- T. E. MEADY—10. Orthopedic clinic.
J. L. KNAFF—11. General surgery.
J. B. HADLEY—2. X-ray demonstration.

Wednesday

- G. F. THOMPSON—9. Stomach and intestinal surgery.
J. W. MCCONNELL—10. Gynecology.
J. J. GRAHAM— General surgery.

Thursday

- H. J. DOOLEY—9. Urological clinic.
E. P. VAUGHAN—9. Gall-bladder surgery.
E. P. GRAHAM—9. Treatment of head injuries.
J. L. FLEMING—11. Pathological obstetrics.

Friday

- B. W. BLACK—9. General surgery.
Staff—10. Clinical meeting.
D. F. HAYES— General surgery.
L. R. HILL—2. Pathological demonstration.

ILLINOIS CENTRAL HOSPITAL

Tuesday

- HUGH M. MACKENNIE—9. General surgery.
PHILIP H. KREDSCHER—9. Orthopedics.

Wednesday

- CHARLES PRITCHER—9. General surgery.
BEVERIDGE MOORE—9. Orthopedics.

Thursday

- S. CLIMENT HOGAN—9. General surgery.
VICTOR LIEPMAN—9. Genito-urinary surgery.

Friday

- WILLIAM T. HARRIS—9. General surgery.
JAMES GILL—9. Neurologic surgery.
JOHN J. GILL—9. Obstetrics.
CHARLES GUY and A. H. B. TURNER—9. Pathological conference.

GARFIELD PARK HOSPITAL

Tuesday

- JOHN R. HUNGER and SAM PLACK—9. Surgery of the stomach; treatment of peptic ulcer.
L. F. MACDONALD—9. General surgery.

Wednesday

- CLAUDE WELDT and JOHN H. FLOCK—9. Abdominal surgery.

Thursday

- J. M. BEILER and FRANK CHAUVET—9. General surgery.

Friday

- CLARENCE SAKELSON—9. Diphasic strains of bacteria from renal lesions, experimental production of lesions with spirillum (apnochaeta pallida).
VICTOR J. O'CONNOR—9. Tuberculosis of kidney with review of cases; hydronephrosis, plastic repair of nephropexy.

EVANGELICAL HOSPITAL

- G. ERMAN JOHNSON. Clinical studies of extra-uterine pregnancy.
FRANCY E. HOPKINS. Clinical studies of pancreatitis.
CHARLES PARK. Treatment of lower limb fractures by fixed traction.
PAUL GEORGE PAPENBERG—Demonstration of models and photographs showing newer methods of the handling of fractures of the maxilla and mandible.

AMERICAN HOSPITAL

Tuesday

- R. B. MALCOLM—9. Surgical clinic, tumors of the neck.
MAX THORER and PHILIP THORER—9. Surgical clinic, carcinoma of the rectum.
W. B. GREENUOD—9. General surgical clinic.
FRANK E. SIMPSON—2. Radium treatment of carcinoma of the mouth and tongue.
SOLOMON GREENSPAN and FREDERICK BOWE—2. Management of placenta previa.

Wednesday

- MAX THORER and PHILIP THORER—9. Surgical clinic.
HORACE E. TURNER and S. GREENSPAN—9. Casualty surgical clinic.
DAVID H. PARDOLE and LEON BEILER—9. Urological clinic.
FRANK E. SIMPSON—2. Radiological clinic, carcinoma of the breast and female genitalia.

Thursday

- BENJAMIN GOLDBERG and JOHN F. PECK—9. Indications and technique for surgery of the chest.
FRANK E. SIMPSON—2. Radiological clinic, indications and contraindications to radium treatment.

LITTLE COMPANY OF MARY HOSPITAL

Monday

- W. D. STANLEY—2. Management of eclamptic patients.

Tuesday

- L. L. CHARPTEK—9. Management of fractures about the elbow.
J. E. LAINE—10. Treatment of carcinoma of the bladder.

Wednesday

- E. D. HUSTINGTON—9. Gastro-intestinal surgery complications.

Thursday

- L. L. CHARPTEK—9. Management of compound fractures.
W. A. MALONE—10. Radium treatment of carcinoma of the cervix.

Friday

- A. W. WOODS—9. Gynecological repair operations.
E. D. HUSTINGTON—9. Intestinal obstruction.

HENROTIN HOSPITAL

Tuesday

- CHRYSTO BARRETT—9. Gynecological operations.
F. LEE STONE—9. Some problems in tubal patency.

Wednesday

- JOHN A. GRAHAM—11. Open reduction of fractures.

ALEXIAN BROTHERS HOSPITAL

Tuesday

- MALCOLM L. HARRIS, AUGUST ZIMMERMAN, ROBERT FLANNERY and GEORGE L. APPELBACH—9. General surgery.
A. WOCHINSKI and EDWARD WHITE—9. General surgery.

U. S. MARINE HOSPITAL

Wednesday

- O. E. NADÉAU—9. General surgical clinic.

Friday

- O. E. NADÉAU—9. General surgical clinic.

SURGERY OF THE EYE, EAR, NOSE AND THROAT

RESEARCH AND EDUCATIONAL HOSPITAL

Otolaryngological Staff F. L. LUDERER, W. H. THEOBALD
J. J. THEOBALD, G. S. LIVINGSTON, E. A. BREIDLAU
N. FOX, S. L. SHAPIRO, L. G. SHEPHERD, P. A. HALZER,
A. C. KANE, A. COOMBS, J. HARRIS, O. VAN ALSTEN,
M. GUTTMAN, S. MORAWITZ, M. OSTROM, B. LAM
BRACK, E. HARTLETT, H. KLAUWAGE, L. FISHERMAN
H. WANDSWORTH, J. BEZLOWSKY and N. FABRICANT
Ophthalmological Staff HALLARD BEARD, M. L. FOLK
R. J. SMITH, S. WOLF, S. KAUFFMAN, CARL APPEL
and J. W. CLARK.

Monday

Staff—1. Otolaryngological out-patient clinic.

Tuesday

Staff—9. Ophthalmological clinic, operations and demonstrations.

Staff—10. Otolaryngological out-patient clinic.

Staff—2. Otolaryngological clinic, operations and demonstrations.

Wednesday

Staff—9. Eye clinic.

Staff—10. Otolaryngological out-patient clinic.

Staff—2. Otolaryngological out-patient clinic.

Staff—4. Otolaryngological seminar.

Thursday

Staff—9. Otolaryngological operations.

Staff—9. Eye clinic.

Staff—10. Otolaryngological out-patient clinic.

Staff—2. Otolaryngological clinic, operations and demonstrations.

Staff—2. Otolaryngological out-patient clinic.

Friday

Staff—9. Eye clinic, operations and demonstrations.

Staff—10. Otolaryngological out-patient clinic.

Staff—2. Otolaryngological out-patient clinic.

MICHAEL REESE HOSPITAL

Monday

H. S. GRADLE—2. Eye surgery.

Tuesday

M. L. FOLK—2. Eye surgery.

Wednesday

M. L. FOLK—2. Eye clinic.

H. S. GRADLE—2. Surgical eye clinic.

ROBERT VON DER HEYDT—3. Silt lamp demonstration.

WASHINGTON BOULEVARD HOSPITAL

Tuesday

L. McBRIDE—2. Nose and throat clinic.

Wednesday

VIRGIL WESTCOTT—2. Eye clinic.

LITTLE COMPANY OF MARY HOSPITAL

Wednesday

H. T. NASH—10. Emergency surgery of the eye.

FRANCES E. WILLARD HOSPITAL

Thursday

WILLARD D. BROOK—10. Surgery of throat and nose.

COOK COUNTY HOSPITAL

Monday

EARLE B. FOWLER—2. Ophthalmology.
S. PEARLMAN and N. LEVIN—2. Esophagoscopy and bronchoscopy surgery of the neck.

Tuesday

THOMAS D. ALLEN—2. External diseases of the eye.
I. MURKAT—2. Clinical and surgical otolaryngology plastic surgery of face and nose.

Wednesday

L. T. CURRY—9. Otolaryngology clinical and surgical cases.

WILLIAM F. MONTGOMERY—9. Ophthalmic neurology and ophthalmology.

Thursday

SANFORD R. GIFFORD—9. Ophthalmic surgery.
CHARLES F. KROGER—11. External diseases of the eye.
S. PEARLMAN and N. LEVIN—2. Esophagoscopy and bronchoscopy surgery of the neck.

Friday

T. C. GALLOWAY and M. T. LAMPERT—10. Malignancy about the head, diathermy.

THOMAS D. ALLEN—2. Ophthalmic surgery.

I. MURKAT—2. Clinical and surgical otolaryngology plastic surgery of face and nose.

WESLEY MEMORIAL HOSPITAL

Tuesday

ROBERT BLUM—9. Eye clinic.
OTIS H. MACLAY—10. Nasal sinus surgery and demonstration of culture technique for the examination of maxillary and frontal sinuses.

Wednesday

THOMAS P. O'CONNOR—10. Otolaryngological clinic.
A. H. ANDREWS, E. B. DRILLON, A. H. ANDREWS, JR.—2. Mastoid operations on cadaver showing simple, modified and radical operations, with a discussion of the indications for each.

Thursday

CHARLES B. YOUNGER—9. Nose, throat and ear operative clinic.

Friday

ROBERT BLUM—9. Eye clinic.
OTIS H. MACLAY—10. Nose, throat and ear clinic.

MERCY HOSPITAL

Tuesday

GEORGE T. JORDAN—9. Nasal ganglion.
L. G. HOFFMAN—9. Cataract extractions.
C. H. CHRISTOPHER—9. Bronchoscopy.

Wednesday

GEORGE MURGRAVE and ALFRED FAISLEY—9. Frontal sinus operation local anesthesia modified mastoid operation with complete removal of flap presentation of cases.

Thursday

ULYSSES J. GRIM—9. Radical antrum and mastoid.
DENO O'CONNOR and RAY EYERMAN—9. Ocular tumors.
CARL SCHAU—9. Focal infection in iritis.

CHICAGO EVE, EAR, NOSE AND THROAT
HOSPITAL

Tuesday

- H B FULLER—9. Mastoid surgery
 WILLIAM A HOFFMAN—9. Eye, ear nose and throat clinic
 WILLIAM A FRISER—9. Cataract operations
 L SAVITT—9. Removal of tonsils by diathermy
 OSCAR B NUENT—11. Eye clinic
 O M STEFFENSON—1. Ear nose and throat clinic
 T S KAMMERLING—1. Eye ear nose and throat clinic

Wednesday

- O M STEFFENSON—9. Tonsil dissection
 OSCAR B NUENT—9. Cataract operations
 WILLIAM A HOFFMAN—9. Eye clinic
 OSCAR B NUENT—1. Eye clinic
 O M STEFFENSON—1. Ear nose and throat clinic
 L SAVITT—1. Ear nose and throat clinic
 H B FULLER—1. Eye ear nose and throat clinic

Thursday

- WILLIAM A FRISER—9. Eye operations
 WILLIAM A HOFFMAN—9. Eye, ear nose and throat clinic
 L SAVITT—10. Physical measures in otolaryngology
 O M STEFFENSON—1. Ear nose and throat clinic
 L SAVITT—1. Ear nose and throat clinic
 OSCAR B NUENT—11. Eye clinic
 T S KAMMERLING—1. Eye, ear nose and throat clinic

Friday

- O M STEFFENSON—9. Tonsil dissection
 WILLIAM A HOFFMAN—9. Eye, ear nose and throat clinic
 OSCAR B NUENT—9. Physical therapy in diseases of the eye
 H B FULLER—9. Functional testing
 O M STEFFENSON—1. Ear nose and throat clinic
 OSCAR B NUENT—1. Eye clinic
 H B FULLER—1. Eye ear nose and throat clinic

MOUNT SINAI HOSPITAL

Monday

- J C BECK, M R GUTMAN and associates—2. Septum cases of uncommon variety discussion and presentation of cases of malignancy about the nose and pharynx carcinoma of the larynx presentation of laryngectomized patients

Wednesday

- A LEVIN, S M MORRIS and associates—3. Septa associated with ear disease cases of labyrinthitis, treatment of atrophic rhinitis

Friday

- J LORCHUTZ, M A GLATT and associates—2. Orogenic septic meningitis with recovery; otogenic sepsis with death following blood transfusion tracheobronchial Hodgkin disease bronchial melanoma laryngeal chondrosarcoma

AUGUSTANA HOSPITAL

Wednesday

- ALFRED MURRAY—1. Eye, ear nose and throat clinic

EVANGELICAL HOSPITAL

- G HENRY MURPHY—Technique and interpretation of hearing tests and techniques and interpretation of tests of the static labyrinth

ST LUKE'S HOSPITAL

Monday

- EARL VERNON—2. Ophthalmological clinic

Tuesday

- E. FINDLAY and RICHARD GAMBLE—2. Ophthalmological clinic
 J T CAMPBELL, JOHN A. CAVANAUGH, HORACE R. LYONS, L. P. NORCROSS, WALTER H. THORWALD, STEVEN A. SCIARETTA, ARTHUR J. COOMBS and CLIFFORD L. DOUGHERTY—2. Otolaryngological clinic

Wednesday

- ALVA SOWERS—2. Ophthalmological clinic
 J T CAMPBELL, JOHN A. CAVANAUGH, HORACE R. LYONS, L. P. NORCROSS, WALTER H. THORWALD, STEVEN A. SCIARETTA, ARTHUR J. COOMBS and CLIFFORD L. DOUGHERTY—2. Otolaryngological clinic

Thursday

- FRANK BRANLEY and JAMES W. CLARK—2. Ophthalmological clinic
 J T CAMPBELL, JOHN A. CAVANAUGH, HORACE R. LYONS, L. P. NORCROSS, WALTER H. THORWALD, STEVEN A. SCIARETTA, ARTHUR J. COOMBS and CLIFFORD L. DOUGHERTY—2. Otolaryngological clinic

Friday

- E. FINDLAY and RICHARD GAMBLE—2. Ophthalmological clinic

OAK PARK HOSPITAL

Tuesday

- HOWARD RIORDAN—9. Demonstration of new nasopharyngoscope on the cadaver and living

Thursday

- HOWARD RIORDAN—9. Treatment of maxillary abscess with the cold quartz lamp new method of treatment of maxillary polyp by diathermy

Friday

- GEORGE W. THORWALD—9. Demonstration of eye tumor, ophthalmic surgery

COLUMBUS HOSPITAL

Monday

- MICHAEL GOLDBERG—2. Emergency surgery of the eye

Wednesday

- G B LAMBRACKS—9. Indications for operative treatment in acute mastoiditis
 S. SCIARETTA—9. Otolaryngological clinic
 MICHAEL GOLDBERG—2. Eye surgery

Friday

- MICHAEL GOLDBERG—2. Eye surgery

ST MARY OF NAZARETH HOSPITAL

Tuesday

- J J KILLICK—9. Ear nose and throat clinic

Thursday

- J J KILLICK—9. Ear nose and throat clinic

ST BERNARD'S HOSPITAL

Friday

- PHILIP O'CONNOR—2. Surgery of the eye dry clinic

ILLINOIS EYE AND EAR INFIRMARY

Tuesday

- DWIGHT C. ORCUTT—9. Use of flap in cataract work superior rectus tension suture plastic.
LEROY THOMPSON—9. Industrial ophthalmology
CARL H. CHAZOTON—10. Bronchoscopy oesophagoscopy
M. A. GLATT—1. Radical mastoid and radical frontal operations.
E. R. CROSSLAND—2. Intra and extra-ocular surgery
OSCAR CLEFF—3. Radical mastoid operation.

Wednesday

- M. LENDORF—9. Detachment of retina cataracts trephine
Staff—10. Dry clinic.
ULYSSSES J. GENE—1. Radical mastoid and radical antrum operations.
MICHAEL GOLDENBERG—2. Iridectomy operation for glaucoma cataracts controlled tenotomy
JOHN A. CAVANAUGH—3. Radical mastoid operation.

Thursday

- HERBERT WALKER—9. Detachment of retina, Laxon operation.
C. F. YERGER—10. Radical sinus and radical mastoid operations
A. LEWIS—1. Radical frontal operation.
E. K. FINDLAY—2. Intra and extra-ocular surgery
W. A. GROSS—3. Tonsils, diathermy

EVANSTON HOSPITAL

Tuesday

- THOMAS C. GALLOWAY—9. Otolaryngological clinic.

Thursday

- HOWARD L. BALLEWATER—9. Otolaryngological clinic.

Friday

- GAIL R. SOYER—2. Lesions of the fundus oculi, lantern slide demonstration.

AMERICAN HOSPITAL

Tuesday

- HARRY L. POLLOCK AND ASSOCIATES—2. Ear nose and throat clinic

Wednesday

- OSCAR KRAFT—1. Ophthalmological clinic.

PASSAVANT MEMORIAL HOSPITAL

Friday

- J. GORDON WILSON JOHN DELPEZ, CARL BOOKWALTER and ELLISON ROSE—9. Ear nose and throat clinic.
SUFORD GIFFORD, WILLIAM MANN JR and RALPH DAVIS—11. Ophthalmology

ST ANNE'S HOSPITAL

Tuesday

- D. T. GORDON—9. Nose and throat clinic.

Wednesday

- W. A. GRAY—9. Eye and ear clinic.

RAVENSHOOD HOSPITAL

Wednesday

- A. A. MERRILL—10 30. Multi-manages of the eye

PRESBYTERIAN HOSPITAL AND RUSH MEDICAL COLLEGE

Monday

- D. B. HAYDEN—2. Complications of otitis media without rupture of the tympanic membrane.
E. W. HAGGARD—3. Unusual laryngeal and bronchial case
GEORGE E. SHAMBERGER JR. and E. W. HAGGARD—2. Operations on the testis for dacryocystitis
MAX JACOBSON—3. Neurological aspects.

Tuesday

- ROBERT VON DER HEYDT—3. Slit lamp diagnostic clinic

Wednesday

- VERNON LEECH—3. Glaucoma.

Thursday

- BERTHA KLEIN—10. Histopathology of fundus.
T. W. LEWIS—2. Discussion of some difficult problems in the operation for correction of the nasal septum.
L. T. COXRY—2. Demonstration of skiagraphs of the sinuses and mastoids.
R. W. WATSON—2. Nasal findings in allergic cases
C. L. DOUGHERTY—2. Diathermy and its application to the treatment of nose and throat conditions

Friday

- W. F. MONCREIFF—10. External diseases of the eye and endocyclitis.
ELIAS SELLINGER—3. Fundus.

JOHN B. MURPHY HOSPITAL

Monday

- E. F. GARRAGHAN—2. Eye operations.

Tuesday

- L. H. WOLF and PAUL WOLF—10. Mastoid surgery

Friday

- GEORGE W. MARBON—9. Cataracts.

WOMEN AND CHILDREN'S HOSPITAL

Tuesday

- ALICE K. HALL—10. Nose and throat clinic

Wednesday

- FRANCES HADDER—10. Nose and throat clinic

SOUTH SHORE HOSPITAL

Monday

- JOHN W. STANTON—2. Mastoiditis and its complications

Thursday

- JOHN W. STANTON—11. Otolaryngological surgery

CHILDREN'S MEMORIAL HOSPITAL

Wednesday

- GEORGE S. LIVINGSTON and staff—9. Otolaryngological clinic.
RICHARD C. GAMBLE and staff—2. Ophthalmological clinic.

SOUTH CHICAGO COMMUNITY HOSPITAL

Tuesday

- GEORGE E. PARK—3. The center of ocular rotation in the horizontal plane

ALBERT MERRITT BILLINGS HOSPITAL

Tuesday

E V L BROWN—9 Eye clinic.
J R LINDRAY—9 30 Ear, nose and throat clinic.
DEWEY KATZ—2 Eye clinic.

Wednesday

LOUIS BOTHMAN—9 Eye clinic.
T E WALSH—9 30 Ear, nose and throat clinic.
JOHN STOUGH—2 Eye clinic.
J R LINDRAY and G H SCOTT—2 Ear, nose and throat operations.

Thursday

P C KRONFELD—9 Eye clinic.
G H SCOTT and H B PERLMAN—9 30 Ear, nose and throat clinic.
DEWEY KATZ—Eye clinic.

Friday

DEWEY KATZ—9 Eye clinic.
J R LINDRAY and T E WALSH—10 30 Ear, nose and throat clinic.
P C KRONFELD—2 Eye clinic.
T E WALSH and H B PERLMAN—2 Ear, nose and throat operations.

WEST SUBURBAN HOSPITAL

Monday

ROBERT H GOOD—2 Surgery of the nose, motion picture demonstration.

Tuesday

JOHN J THEOBALD—2 Mastoid surgery.

Wednesday

GEORGINA THEOBALD—2 Eye pathological exhibit.

CHICAGO MEMORIAL HOSPITAL

Monday

RICHARD H. STREET and RICHARD W. WATKINS—2 Otolaryngological clinic.

Tuesday

HERMAN F. DAVIDSON and GLENWAY W. VETTERCUT—9 Eye clinic.

Wednesday

ALFRED F. LEWY and IRVING I. MURRAY—2 Otolaryngological clinic.

ILLINOIS CENTRAL HOSPITAL

Tuesday

HIRAM SMITH—9 Eye clinic.

Wednesday

JAMES H. McLAUGHLIN—9 Nose and throat surgery.

GRANT HOSPITAL

Wednesday

S. H. SCHOROFF—9 Ear, nose and throat clinic.
GEORGE F. SIKER—9 Eye clinic.
GEORGE DEWIS—9 Eye, ear, nose and throat clinic.

ILLINOIS MASONIC HOSPITAL

Tuesday

M. H. COTTELL—10. Some advances in mastoid work.
B. M. WOLFE—10. Tonsil surgery in the poor risk case.
H. E. TAYLOR—10. Conservative surgery of the nose.

JACKSON PARK HOSPITAL

Tuesday

H. E. L. TIMM—1 Timm's modification of Sader tonsillectomy.

AMERICAN COLLEGE OF SURGEONS

APPROVED MEDICAL, SURGICAL AND HOSPITAL EQUIPMENT, INSTRUMENTS AND SUPPLIES

THE Board of Regents of the American College of Surgeons, acting on the recommendation of the Approval Committee, has approved the following medical surgical and hospital equipment, instruments and supplies

- AMERICAN ATMOS CORPORATION Pittsburgh, Pa.
Cecil-Mummer oxygen therapy apparatus.
- AMERICAN HOSPITAL SUPPLY CORPORATION Chicago.
Oxygenaire.
- AMERICAN LAUNDRY MACHINERY COMPANY
Cincinnati, Ohio.
Laundry machinery for hospital use
- AMERICAN SURGICAL LAMP COMPANY
Los Angeles, Calif.
American surgical lamps Nos. 11 11B 12 13, 14, 15
31
- APPLIGATE CHEMICAL COMPANY Chicago.
Applegate system for marking linen.
- ARMSTRONG CORE COMPANY Lancaster Pa.
Armstrong's linoleum, cork tile linoleum acetille.
- BARNESTAD STILL AND STERILIZER COMPANY Boston.
Barnestead single, double and triple distilled water
outfits
Longwood hot oil instrument sterilizer
- BAUER & BLACK, Chicago
Absorbent cotton.
Crepe bandage
Gauze bandage
Gauze pocket strips.
Hand-tape.
Handy-fold gauze
Plain gauze.
Surgical sponges.
Woven elastic bandage.
Zinc oxide adhesive plaster
- BAUSCH & LOM OPTICAL COMPANY Rochester N Y
Automatic clinical microtome No 3372.
Biological colorimeter No. 2400.
Colorimeter lamp No. 2414.
Electric centrifuge No. 19030-A.
Hand centrifuge No. 19001
May ophthalmoscope otoscope and diagnostic sets
Nos. 71 12-80.
Microscope No. FFSB
Microscope No. GSET 1-B.
Microscope adjustable No. 4597 R.
Microscope widefield binocular No. KT
Minot automatic rotary microtome No. 3000.
Merton hand ophthalmoscope Nos. 71 12-79.
Newcomer hemoglobin attachment No. 3611 A
Operating lamp on rubber-tired roller stand Nos.
71 26-14.
Ophthalmic operating lamp Nos. 71 26-06.
Paraboloid condenser No. 1726.
- Petri dish holder with stage No. 1717
Plain microtome knife Nos. 3092 3094.
- BELL & HOWELL COMPANY Chicago.
Eyemo No. 71-C 35 mm.
Film motion picture camera, Nos. 70-DA 70-A, 75,
16 mm.
Film motion picture projector Nos. JL, GJ M.
Standard cinematographic camera, 35 mm.
- BRAMHALL, DEANE COMPANY New York.
Bed pan washer steamer and sterilizer
Non-pressure (boiling type) instrument and utensil
sterilizer
Pressure dressing sterilizer and laboratory autoclave.
Pressure water sterilizer.
Steel disinfectors.
- WARREN E. COLLINS, Inc. Boston.
Drinker respirator adult and infant models.
- COLSON COMPANY Elyria, Ohio.
Colson invalid chair and accessories.
- COLUMBIAN ENAMELING & STUMPING COMPANY
Terre Haute, Ind.
Columbian-made enameled ware for hospital use.
- COMPLEX OSCILLATOR CORPORATION New York.
McCarthy surgical unit.
- CONVOLEUM NATEX Kearny, N J
Cork composition sealer linoleum flooring products.
- CRANE COMPANY Chicago.
Hospital plumbing fixtures for hospital use.
- DUKE LABORATORIES, Inc. Long Island City N Y
Elastoplast.
- EASTMAN KODAK COMPANY Rochester N Y
Clinical camera.
Dark room safelights.
Dental X ray film.
X-ray developing hangers.
X-ray film.
X-ray illuminators.
X-ray intensifying screens.
- ELECTRIC STORAGE BATTERY COMPANY Philadelphia.
Exide emergency lighting battery system.
- E. H. ERICKSON ARTIFICIAL LIMB COMPANY
Minneapolis, Minn.
Artificial limbs.
- FOREGGER COMPANY New York.
Flagg resuscitation apparatus.
Guedel oxygen meter and tent outfit.
Henderson infant resuscitation outfit.
Metric gas machine.

FRIGIDAIRE CORPORATION Dayton, Ohio

Frigidaire

GENERAL ELECTRIC COMPANY Incandescent Lamp
Dept. Cleveland, Ohio.

Manda sunlight lamps, types S-1 and S-2.

GENERAL ELECTRIC CORPORATION, Schenectady \ \
Refrigerator

GENERAL ELECTRIC X RAY CORPORATION, Chicago
Quartz lamp series

Shock proof X ray apparatus, models A and B.

GRUNOW CORPORATION Chicago.
Refrigerator

FRANK A. HALL & SONS, New York.
Hospital beds

HANOVIA CHEMICAL & MANUFACTURING COMPANY
Newark, N. J.

Super Alpine sun lamp

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Lundy gas-oxygen apparatus.

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J M asbestos rigid shingles

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J M home insulation

J M system of sound isolation

Nashlote acoustical treatments

Rockwool tile

Sonoacoustic bolorib, panels, tile

Transite asbestos sheets

Transite acoustical tile

JONKES & JONKES, New Brunswick, \ \ J

Absorbent cellulose

Absorbent cotton, rolls and balls

Absorbent gauze

Adhesive plaster

Bandage rolls

Bellevue surgical wadding

Cellulose wipes

Nose and mouth masks

Operating room caps

Orthoplast—plaster-of-pairs bandages.

Specialist plaster-of-pairs bandages

Standard surgical dressings

Surgical crinoline

E. H. KARRER COMPANY Milwaukee, Wis.
Lemon's improved portable traction apparatus.

HENRY L. KAUFMAN & COMPANY, Boston.
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Covington, Ky.
Kelaket plate chargers.
Kelaket tables
Kelaket transformers in excess of 150 P. K. V.
Kelaket X ray accessories.
Kelaket X-ray transformers of \ltages inclusive of
150 P. K. V.

KEWALKER MANUFACTURING COMPANY
Kewaunee, Wis.
Biology and bacteriology table No. C 350.
Chemical proof sink No. F 1195
Chemical work table No. H 1332.
Clinical laboratory table Nos. E-1079, E 081
E-1083.
Dietetic table Nos. K 1825, K 1830
Dissecting table Nos. E-073, E-078.

Double sink No. K 1882A.

Instrument and display case No. G-1376.

Laboratory truck No. F 1173.

Laboratory wall sink No. F 1182.

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KO RAY MANUFACTURING COMPANY Chicago.
Ko-Ray cooker

LEHNER, WHITMAN & COMPANY New York.
Lesher mobatra.

LEWIS MANUFACTURING COMPANY Walpole, Mass.

A B D pads and rolls.

Absorbent cotton.

Adhesive plaster

Bandage rolls

Cellucotton absorbent wadding in rolls.

Cellucotton combination pads.

Celluwipers.

Combination dressing rolls

Combination pads

Combination rolls.

Crinoline for plaster bandages.

Dressing rolls.

Gauze in bolts

Molekin adhesive plaster

Non-absorbent cotton.

No-ravel bandages

O B pads.

Orthopedic stockinette.

Plaster bandages.

Ready-cut cellucotton absorbent wadding.

Ready-cut gauze.

Salvage gauze.

Sheet wadding

Surgical sponges.

MARETT FORGE COMPANY Everett, Mass.

Maforte autopsy tables.

Maforte food veyors

Maforte mortuary racks.

Maforte refrigerator racks.

MAMMILLON RUBBER COMPANY Mansfield, Ohio.

Mater Anode surgical gloves.

NATIONAL CARBON COMPANY Cleveland.

Eveready professional model carbon arc lamp.

Eveready solarium type carbon arc lamp

NORVIG COMPANY Lowell, Mass.

Vic crepe bandage.

PATTERSON SCREEN COMPANY Towanda, Pa.

Fluoroscopic X-ray screens.

Foreign body X-ray fluoroscope.

Intensifying X ray screens.

Operating X-ray fluoroscope.

PFALTZ'S AMERICAN INSTRUMENT COMPANY, New York.

Anatomical specimens for ear, nose and throat.

Surgical instruments for ear, nose and throat work.

SAFETY ANAESTHESIA APPARATUS CONCORD Chicago.

Safety gas-oxygen apparatus, McCurdy models A and
B.

Safety gas-oxygen apparatus, models F and D

- SANTORN COMPANY Cambridge, Mass.
Motor-Grafc metabolism tester
- SCIALYTIC CORPORATION OF AMERICA Philadelphia.
Shadowless operating light.
- SPLAIN & LLOYD, Milford, Ohio.
Sani-swab cotton wound applicator
- STEDMAN RUBBER FLOORING COMPANY South Braintree Mass.
Reinforced rubber accessories—ash trays, bed bumpers, drain mats, molded tops, vase plates, vases.
Reinforced rubber tile.
- STICKLEY BROTHERS COMPANY Grand Rapids, Mich.
Hospital furniture.
- STILLE-SCANLAN COMPANY New York.
Surgical instruments of stainless steel.
- TROY LAUNDRY MACHINERY COMPANY Chicago
Laundry machinery for hospital use
- UTICA & MOHAWK COTTON MILLS Utica, N. Y.
Heavy duty muslin sheets.
- VESTAL CHEMICAL LABORATORIES, St. Louis.
Infantal dispenser
Septisol dispenser
- WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY Mansfield, Ohio
Refrigerator
- WESTINGHOUSE X. RAY COMPANY Long Island City N. Y.
Endotherm.
- WILSON RUBBER COMPANY Canton, Ohio
Surgeons gloves.
- CARL ZEISS, Inc., New York.
Pantophos operating room lamp, models A and B
- ZIMMER MANUFACTURING COMPANY Warsaw Ind.
Fracture bed and overhead frame.

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CARCINOMA ARISING FROM CHRONIC GASTRIC ULCER¹

G GÖMÖRI, M.D., BUDAPEST HUNGARY

IN the more recent medical literature much attention has been directed toward the problem of gastric carcinoma arising from chronic peptic ulcer. Pathologists and surgeons are equally interested as both the problem of etiological relationship between chronic stimulus and tumor and the question of operative treatment of chronic gastric ulcer are involved. As a pathological change is subject to malignant degeneration more radical treatment, of course, is required than for a lesion devoid of this menace.

The theory that malignant degeneration of chronic peptic ulcer is possible cannot be denied. There is ample evidence that malignant tumors may start in the edge of a chronic ulcer, for example Langri cancer, lupus cancer, carcinoma arising in pressure ulcers of the tongue, etc. That long continued stimuli may produce cancer of the stomach has been demonstrated by J. Fibiger. In cancers formed in a gastric ulcer such a stimulus may be represented by the niche where food particles are constantly undergoing decomposition, Mayo found malignant change three times in 42 cases of diverticulum of the large bowel.

The actual relationship between peptic ulcer and cancer, however, is another question. Is there a definite relation between them, and if there is how close is this relationship? What are the chances of a chronic peptic ulcer becoming malignant? Much has been written on the subject and the opinions brought forward differ greatly. Rokitsansky

was one of the first to allude to the possibility of the incidence of peptic ulcer and cancer of the stomach. In 1878, Lebert reported 8 cases of gastric cancer in which typical symptoms of peptic ulcer were observed for many years before death. Hauser was the first to furnish histological evidence of cancer arising from the edge of a chronic ulcer. Since then many reports have been made of such cancers and some of these reports contain data as to the frequency of such lesions. Unfortunately not all of these statistics can be used for comparison as many of the reports obviously are not complete. In only a few instances is the percentage given of gastric ulcers becoming malignant and of carcinoma probably arising from chronic ulcer. Most of the statistics published mention but one of these items the "frequency of ulcer cancers."

As stated the opinions of different authors vary greatly. According to A. Nielsen there is not sufficient evidence to prove that cancers develop on a chronic ulcer base. Hirschfeld does not accept the theory of an etiological relationship between ulcer and cancer. In the opinion of R. Schmidt, patients suffering from chronic ulcer are immune to carcinoma. Henke and Stromeyer stress the rarity of cancers arising from gastric ulcers. Walton expresses the opinion that such cancers are more common than generally believed. According to Fuetterer a great many pyloric cancers arise from chronic ulcers. Table I shows a few statistics on malignant degenera-

¹From the Third Surgical Clinic of the Royal Hungarian Petrus Pilatory University of Budapest. L. Adám, M.D. clinical professor of surgery director.

tion and discloses the discrepancies in opinions. If we accept only those compilations which furnish clear and complete figures and reject all others, the reasons for the differences in opinion may be discussed under three heads (1) the specimen itself (2) the lack of uniformity in technique in studying the specimen and (3) the lack of criteria on which to base a diagnosis.

1. *The specimen* The pathologist is more likely to see fewer cases of cancer arising from gastric ulcer than the surgeon who has the opportunity of resecting early cases. When a case comes to autopsy the tumor has progressed so far that the entire floor of the ulcer is so extensively destroyed that it is almost impossible to determine whether or not there had been a pre-existing ulcer (Payr).

TABLE L.—STATISTICS AS TO MALIGNANT DEGENERATION

| Author | Carcinoma from degeneration of ulcer per cent | Carcinoma arising from chronic peptic ulcer per cent |
|---------------------|---|--|
| Borrmann | | 1 |
| Paterson | | None |
| Garré | 3 to 5 | |
| Orator | 3 to 5 | 10 to 15 |
| Payr | 26 | |
| Moyman | 18.5 | about 66 |
| Newcomb | 3.5 | 13 |
| McCarthy and Wilson | | 71 |
| McCarthy | 68 | |
| Brinkmann | 5.5 | |

2. *Technique of studying specimen* Statistics based upon clinical and macroscopical observations only should be discarded for as will be pointed out later positive proof of cancer developing on an ulcer base can be had only upon microscopic examination. Even material worked up with the utmost care may show marked deviations, depending on what cases are included in the series. It should be remembered that many surgeons are very radical in that they resect almost all ulcers even subacute ones, coming to their care. If all ulcers observed are included the rate of carcinomatous degeneration would be very low. In our opinion all ulcers should not be included. Acute or even subchronic ulcers are not considered as liable to malignant change. Therefore only callous ulcers, positively chronic, should be included. If only these are accepted, the percentage will be

much higher. Most of the articles published are not clear on the point as to whether or not the ulcer is of the long standing callous type. It is for this reason, we believe, that the statistics show such marked discrepancies.

3. *Criteria for diagnosis* Opinion is not yet uniform as to the criteria for and possibility of determining that a cancer has developed from an ulcer. We should like to go more fully into detail as to this question before commenting upon our own cases.

The symptoms of cancer secondary to ulcer will be dealt with from three standpoints (1) the clinical (2) the pathological and macroscopic and (3) the histological features.

From a clinical standpoint the symptoms point to the possibility of an ulcer undergoing cancerous degeneration if the symptoms of ulcer—pain after taking food, pyrosis, sour eructation etc.—after long standing years or decades, gradually change into typical symptoms of gastric cancer—almost permanent dull ache, aversion to food, rapid loss of weight, cachexia. Of course even more convincing are characteristic changes in the laboratory and X-ray findings. In several cases in which gastro-enterostomy had been performed many years previously malignant degeneration of gastric ulcer was observed at a second operation. We had a case in our clinic in which there was a 5 year interval between the operations. Unfortunately it was possible to examine only a lymph gland near the pylorus in which adenocarcinoma was demonstrated.

All cases of gastric cancer with normal or even increased hydrochloric acid should arouse suspicion of malignant degeneration of peptic ulcer. Moreover long anamnesis in itself points to previous ulcer as according to Lebert 83 per cent of patients with gastric cancer die within 18 months, 9 per cent within 2 years, the remaining 8 per cent within 4 years, the latter being without exception scarious cancers. Such cases as that of Paterson—one patient alive 3 years, the other alive 4½ years after gastro-enterostomy for inoperable cancer—are extremely rare.

These symptoms however do not give entirely satisfactory data for the diagnosis of cancer secondary to ulcer. Often laparotomy



Fig. 1. Chronic peptic ulcer showing unchanged relation of muscularis mucosae and muscular coat. Iron hematoxylin stain. $\times 15$.



Fig. 2. Progressive separation of muscularis mucosae and muscular coat toward the ulcer edge in chronic peptic ulcer. Iron hematoxylin stain $\times 15$.

in a case which seems typical for ulcer, reveals no ulcer. In such cases according to Hauser and Versé the underlying pathological change is chronic gastritis. On the other hand, absence of symptoms does not exclude the possibility that ulcer has been present as has been demonstrated by the accidental finding at autopsy of an ulcer and the great number of sudden perforations without a previous history of ulcer. As to the malignant degeneration of an ulcer for which a gastro-enterostomy has been performed which malignancy is detected at a second operation, it is questionable whether the ulcer was not already malignant at the time of the first operation. If considerable time has elapsed between the first and second operations the probability of the latter assumption decreases, especially if the tumor is of small size at the time of the second operation.

Macroscopic examination of the operative specimen gives more certain findings. In the first place the location of the lesion is of importance. Malignant degeneration of a duodenal ulcer is extremely rare. On the other hand, malignant change in a pyloric or prepyloric ulcer is found ten to fifteen times more often than in ulcers situated higher along the lesser curvature. Ulcers 2 centimeters or more in diameter are said to be especially liable to malignant degeneration.

It is rather difficult to give a comprehensive macroscopic picture of a cancer secondary to ulcer as the picture varies according to the stage of development. In the beginning, sometimes even in a rather advanced stage, it cannot be distinguished from a simple chronic, peptic ulcer all the characteristic

features of which it possesses. In some cases there is a sharply circumscribed round or oval defect in the mucosa, at the edges of which the mucosa is rolled inward and fixed to its base. In other cases the edges are undermined, overhanging and rigid. The mucosa around the ulcer is often thrown into radial folds. The floor of the ulcer consists of dense scar tissue, smooth and never crumbling, in extreme cases it may be 2 centimeters thick. The defect often has the shape of an inclined funnel, the steep wall of which is at the cardiac edge while it slopes gently toward the pyloric edge. This shape is very probably characteristic of chronic peptic ulcer as according to most authors, it corresponds to the area containing the normal arterial supply of the stomach. Primary cancer destroys all vessels with which it comes in contact and a shape characteristic for the obstruction of only one of the larger vessels is an exception and will develop only by chance.

The most convincing signs of peptic ulcer are observed in cross sections of the ulcer. We find there the following characteristic picture of the muscular coat. At the outer edge the muscle fibers radiate as a sharply limited tight strand in an acute or even a right angle to the ulcer floor where they are lost. This condition is the result of a cicatricial contraction by which the musculature is pulled toward the center of the ulcer where it will eventually be entirely destroyed. No muscle tissue is found in the ulcer base. If a pre-existing cancer becomes ulcerated, this behavior of the muscle coat is never observed as the muscle becomes 'grubbed up' and the fibers are widely spread by the invading



Fig. 3. Case 1. Photomicrograph showing the edge of the ulcer *a*, Muscular coat *c* carcinomatous glands in ulcer base $\times 38$

neoplasm. Another characteristic sign some times visible with a hand lens but more often seen only with the microscope is fusion of the muscularis mucosae and the muscular coat at the edge of the ulcer. The importance of this sign will be dealt with in the histological discussion.

Very often extensive peritoneal adhesions are present. The omentum may be fixed in radial folds to the base of the ulcer and some times the base of the ulcer is formed merely by these adhesions. In cancer extensive adhesions are seldom present, even in case of complete perforation.

If the ulcer shows only the signs described it cannot be distinguished from a simple chronic ulcer. At times, however at some part of the ulcer edge a medullary swelling of the mucosa is observed, which may extend into the ulcer base. The cut surface shows a white soft nodule. Care should be taken in any case as the prepyloric mucosa is prone to produce benign hyperplasia and the picture may be similar. Diagnosis will depend on microscopic examination. Later the tumor invades the ulcer base and its environs, and after the breaking down of the neoplastic tissue the picture of the original callous ulcer will be entirely blurred. In this stage a typical crater-like ulcer is seen with irregular everted hard edge and an uneven, crumbling floor or in cases of scirrhus cancer

there is a widespread callous thickening of the stomach wall. In this phase the ulcer cannot be distinguished from a primary cancer.

I will mention here a very rare and interesting form of cancer secondary to ulcer—a scar cancer. In several instances there was observed in the linear scar of an hour-glass stomach a circumscribed medullary tumefaction which, on microscopic examination, proved to be a carcinoma.

Summarizing the principles of macroscopic diagnosis of cancer secondary to peptic ulcer those signs are to be taken into consideration which show that scarring took place in a stomach wall previously not invaded by tumor and medullary swelling of the mucosa at the edge of the ulcer. The most valuable signs are the typical form of the ulcer defect, that is the turning up of the muscle layer toward the ulcer floor and external adhesions.

As shown macroscopic diagnosis is not always dependable, whereas histological examination will establish the diagnosis with certainty in most cases, provided proper care has been used in making the examination. Two problems arise in making the histological examination (1) the seeking of evidence to determine the presence of cancer and (2) the seeking of evidence that the cancer started in the margin of a pre-existing callous ulcer.

The first problem cannot always be easily solved. As mentioned the prepyloric mucosa is prone to produce hyperplastic growth. Glands of this hyperplastic mucosa are sometimes not entirely regular their cells may show some polymorphism and be stained darker than those of the surrounding mucosa—the much debated “dark cells” of the literature. It is at times difficult to distinguish the growth from adenocarcinoma. In determining malignancy personal feeling is liable to play a great rôle as unmistakable criteria are often lacking. This fact may explain in part the wide range of malignant degeneration in chronic ulcers as described by different authors. In our opinion it should be assumed that cancer is present only if in addition to the known symptoms of malignancy there can be no mistake in interpreting other signs, for instance the presence of a distinct neoplastic infiltration of the submucosa. A

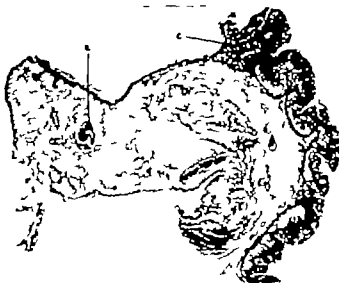


Fig. 4. Case 2. Edge of ulcer c, Carcinoma a, endarteritic vessel. $\times 3.3$.

few isolated glands do not necessarily indicate malignant change.

It should be emphasized that it is not enough to examine one block of tissue taken from the edge of an ulcer. Although in many cases the cancer will have invaded the entire circumference and thus can be demonstrated in any block taken at will, there are a great many cases in which the tumor is confined to a very small part of the ulcer margin. Preparing serial sections from the entire ulcer area in every case is not feasible, 4 to 6 blocks at least, must be examined, however.

As to the second question, the search for microscopic signs of callous ulcer, it will be noted (1) The ulcer floor consists of a mass of granulation and scar tissue which becomes more fibrous toward the deeper layers. This tissue occupies the entire ulcer base and spreads beyond the margins of the ulcer as a cicatrized broadening of the submucosa. It may reach as deep as the serous coat and in the presence of external adhesions it may involve the organ to which it adheres—the omentum, the pancreas, etc. (2) The ulcer base is entirely devoid of muscle tissue. At the ulcer edge the muscular coat radiates as a sharply demarcated, tight strand in an acute angle into the floor of the ulcer. The muscularis mucosae is very often pulled, in the process of scar tissue formation to the muscular coat. Thus both layers become closely



Fig. 5. Case 2. Vessel shown in Figure 4. $\times 30$.

approximated or even fused at the ulcer margin. Newcomb found this condition, at least in some part of the ulcer margin, in 98.8 percent of his cases. In the study of our material we were not able to confirm this point as in 64 cases of chronic peptic ulcer we found actual fusion in but 34 cases, some approximation in 22 cases, and unchanged position (Fig. 1) in 5 cases. In 3 cases distinct progressive separation of both layers toward the ulcer edge (Fig. 2) could be observed. Undoubtedly, if scarring should proceed without disturbance for a considerable length of time, the muscular layers would become approximated. It is known, however, that the natural history of a peptic ulcer includes periods of ulceration alternating with periods of healing. Whether or not the sign described will be found depends largely on the phase which happens to prevail at the time of examination. That scarring does not necessarily cause fusion of the muscle layers is shown also by the fact that in most cases of even entirely quiescent ulcers, scarring is not noticeable completely around the ulcer edge but only in some parts of it. (3) Obliterated endarteritic vessels can be found in the base of the vast majority of peptic ulcers. Many pathologists believe that they are of etiological importance. Endarteritis is also observed in primary cancers but occluded vessels of larger caliber, 1 to 2 millimeters in diameter deep in the ulcer base, surrounded by tissues showing only a moderate or no inflammatory reaction, occur almost exclusively in chronic peptic ulcers.



Fig 6 Case 3 Operative specimen $\times 0.5$

If somewhere in the margin of an ulcer presenting the criteria mentioned carcinomatous proliferation is noted, and at the same time the greater part of the ulcer margin and base are tumor free there can be no doubt as to the diagnosis—cancer arising from a chronic peptic ulcer. Cancer detected in this stage is comparatively rare. In most cases cancer tissue is found completely around the periphery of the ulcer. This phenomenon may be the result of two things: (1) the neoplastic process may have started simultaneously at several points in the ulcer margin the stimulus being present in all parts of the ulcer edge, or (2) as the tumor could not penetrate into the dense fibrous ulcer base the growth took place around the margins which offer less resistance. The tumor cells may often be absent in the entire thickness of most of the ulcer base. In other cases the dense, cicatrized layers extending toward the gastric lumen contain no tumor cells, but the subserous layers are infiltrated. This is explained by the fact that it is easier to invade the loose tissues. Stromeyer does not recognize lesions in this not entirely initial stage as cancers arising from ulcers but considers them as primary cancers ulcerated away and cicatrized to such an extent that no cancer cells can be observed in the scar tissue. Moreover he suggests that the rate of scar tissue formation may exceed that of the neoplastic growth and in this way the entire ulcer base may become cancer free. According to him diagnosis in these cases should not be *carcinoma ex ulcere* but *ulcus in carcinomate*. Borrmann is of the same opinion and believes that cancers from ulcers are rare.

He accepts only those cases in which but a small part of the ulcer margin is occupied by tumor and in which the ulcer base is entirely devoid of cancer cells. He does not believe in a close etiological relationship between ulcer and cancer as he found malignant change in only 1 per cent of all ulcers. He puts forth the following considerations: (1) How can it be explained that in the superior horizontal part of the duodenum where ulcer is so frequent, cancer is a rarity whereas in the region of the ampulla where ulcer is exceptional cancer is rather often seen? (2) It is difficult to realize how a cancer produces an annular growth around the ulcer margin as cancer in general shows a uniform centrifugal growth. Until it reaches the opposite margin after encircling the ulcer border extensive infiltration far in all other directions must have resulted. In this stage a large carcinomatous infiltration with eccentric ulcer is to be expected rather than a lesion with a uniform annular border. That the neoplasm begins simultaneously in several points, which in some cases seems to be more than probable Borrmann cannot believe. He mentions the queer fact that no cases are known in which the greatest part of the ulcer edge is occupied by cancer but only those cases are mentioned in which the tumor is limited either to a small focus or in which the tumor forms a closed ring. Since Borrmann's contribution Klein and Demuth have reported the first case of cancer secondary to ulcer in which the neoplastic ring was not entirely closed.

It is true that very few cases recorded in the literature give exact data as to the extension of the malignant involvement. We believe that as more cases are examined thoroughly there will be an increase in the number in which the neoplastic ring is nearly closed. As far as we know Case 4 in our series is the second case reported in the literature. Klein and Demuth advance the following arguments against the theory of Stromeyer. Ulceration of the carcinomatous tissue may be acute or chronic. In the acute type signs of acute reaction and masses of necrotic tumor tissue must be present in the ulcer base which must be infiltrated even in the chronic case, as according to Stromeyer cancer is already present

when the ulceration and scarring commences at which time there is no rigid scar tissue but only succulent, cellular granulation, which is easily infiltrated by carcinoma. Complete sloughing away of the tumor by a phlegmon or abscess as suggested by Stromeyer is highly improbable as in the ulcer base entirely or nearly normal vessels of considerable size, evidently not newly formed ones are always present. In extensive pyogenic destruction, through which the entire tumor would slough away *en masse* leaving not a trace behind the vessels must have suffered considerable damage. Wasting away of the tumor, through pressure of its own stroma, can be ruled out as cancers secondary to ulcers are almost without exception highly cellular adenocarcinomata entirely lacking in scirrhous features. The opinions of Stromeyer and Borrmann are not accepted by Hauser who says that it is difficult to realize that exactly in the center of a carcinoma a peptic ulcer would develop to destroy evenly almost the entire tumor and to leave but a narrow margin. According to the great majority of contributors, those callous carcinomatous ulcers the greater part of the floor of which is free from cancer can be safely regarded as cancers secondary to ulcers.

Of course, in time the tumor will invade the entire ulcer base. Considerable difficulty may be met with in diagnosing these cases. Often, if the ulcer base is not too extensively destroyed fair evidence of previous peptic ulceration may be present. Here too the symptoms and signs of chronic ulcer must be searched for. Later in the process of the disease the original structure may be unrecognizably blurred by the neoplastic growth. In such cases of course it would be impossible to state that the cancer had arisen on an ulcer base. Very probably in this stage of the lesion many cases are seen and the origin of the lesion is not even suspected.

We shall mention another diagnostic sign stressed by several authors but in our series found to be entirely without dependence namely the different locations of concomitant gastric lesions. It is alleged that with peptic ulcer and secondary cancer pyloric gastritis prevails whereas cancer is generally associated with diffuse gastritis.



Fig 7 Case 3 Tubercle and carcinoma in ulcer base. X75

In the relation between ulcer and cancer another possibility should not be overlooked namely that a carcinoma arising independently in the vicinity of the ulcer would break into the latter. In this case however, the tumor tissue is most voluminous at its starting point and not at the ulcer margin.

AUTHOR'S CASES

Our material consists of operative specimens removed at the Third Surgical Clinic of the University of Budapest from September 1 1929 to January 1 1933.

| | |
|--|-----|
| Number of specimens | 166 |
| Gastric ulcer | |
| Chronic | 64 |
| Subchronic and subacute | 7 |
| Duodenal ulcer | 41 |
| Jejunal ulcer | 4 |
| Gastric carcinoma | 28 |
| Linitis type | 2 |
| Gastric lymphosarcoma | 1 |
| Hypertrophy of pylorus | 2 |
| Duodenal diverticulum | 1 |
| Gastritis | 1 |
| Tuberculosis of stomach | 1 |
| Palliative resections for duodenal ulcer | 8 |
| Cancers secondary to ulcer | 6 |

In every case of cancer secondary to ulcer at least 4 blocks from different parts of the ulcer edge have been removed for histological examination except in Case 1 which unfortunately was not worked up systematically and therefore we are unable to give the topography of the tumor.

CASE 1 A man aged 57 years came to the clinic for severe hunger pains of 1 year's duration, sour eructations and hematemesis. In spite of a good

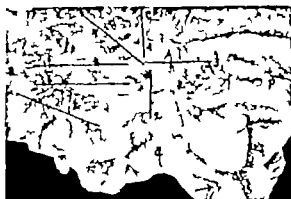


Fig. 8. Case 4. Part of operative specimen. c, Cardiac edge; d, duodenal edge; a, anterior wall; p, posterior wall. Arrow indicates entrance of diverticulum. Natural size.



Fig. 9. Case 4. Anterior stomach wall edge, block 3. Benign papillary hypertrophy at ulcer edge. X7.

appetite he lost 6 kilograms in weight. Test meal yielded free hydrochloric acid, 40; total acidity, 60. At laparotomy a stellate scar was found in the distal third of the lesser curvature, to which the gastrocolic ligament and the greater omentum were adherent. The hepatogastric ligament was shortened and infirmed. Extensive resection of the stomach was performed. In the specimen removed a round prepyloric ulcer was found 45 millimeters in diameter. It had the shape of a shallow funnel and had a smooth, firm, whitish floor and elevated, strongly overhanging edges. Its base was formed by a thin layer of scar tissue and adherent omentum. The cut surface showed a pea sized, white, soft nodule just beneath the edge of the mucosa. This nodule was present in three sections taken from different parts of the ulcer.

Histology (Fig. 3). The ulcer base was formed by granulation tissue becoming highly fibrous toward the depth. The surface was covered with a thin layer of necrotic material. At the center the fibrous layer was very thin and underneath it the base of the ulcer was formed by the fatty tissue of the omentum. The muscular layer radiated under a right angle into the ulcer floor where it was lost. The space between the muscularis mucosae and the muscular coat was rather increased by scar tissue broadening of the submucosa, which could be followed for about 15 millimeters from the ulcer edge. At the ulcer edge both layers became even more separated by invasion of a highly atypical glandular tissue. In one of the blocks a gradual transition from normal gastric glands into carcinomatous ones could be observed. In the other blocks too the ulcer edge was formed by adenocarcinoma, no transitions, however being observed. The neoplastic tissue seemed to invade the mucosa rather than below. Groups of atypical glands decreasing in size toward the center were seen for about 12 millimeters from the ulcer margin. In the center of the ulcer base an area of about 20 millimeters in diameter was entirely

free from neoplasm. In the fibrous tissue, several arteries of 0.35 to 0.5 millimeters in diameter containing organized thrombi were seen. Cells of the neoplastic glands showed considerable polymorphism and a great number of mitotic figures.

CASE 2. A man aged 66 years, complained of epigastric pain and vomiting of 1 year's standing. In the last months he vomited coffee-ground-like masses. In the epigastrium a tender mass could be palpated. Because of the bleeding no test meal examination was carried out. At operation a mobile tumor the size of a child's fist was found near the pylorus on the lesser curvature. The distal two-thirds of the stomach was resected. In the specimen a prepyloric, funnel shaped ulcer with slightly raised and overhanging borders, about 40 millimeters in diameter was seen. The ulcer floor consisted of a hard, smooth, whitish tissue. In the cross section of the ulcer an upward turning of the muscular coat was conspicuous. At the cardiac edge a pea sized, white nodule was noticed beneath the mucosa. Six blocks were removed for microscopical examination.

Histology (Fig. 4). The ulcer base was formed by the granulation tissue becoming highly fibrous toward the depth and was covered by a necrotic layer. In the connective tissue which presented heavy lymphocytic and eosinophilic infiltration, several large endarteritic, partially obliterated arteries were seen (Fig. 5). The scar tissue broadening of the submucosa could be followed far from the ulcer margin beneath the mucosa. At the ulcer edge the muscular coat radiated as a compact strand into the ulcer floor at an angle of about 60 degrees, and then was lost. At some points a close approximation of the muscularis mucosae and the muscular coat could be observed. All around the margin of the ulcer the mucosa presented a similar picture. Near the margin of the ulcer the glands became deeper, were ramified, and showed lumina filled with papillary projections. The glands penetrated the muscularis mucosae and the superficial layer of the muscular coat at some places having reached even the subserous tissue.



Fig. 10. Case 4. Duodenal edge, block 2. Rarefied area shown by arrow, "Swarm" of epithelial cells invading submucosa. $\times 97$

The glands were lined with several layers of tall cylindric epithelium which showed moderate polymorphism and a few mitotic figures. In general atypical glands were found only a few millimeters from the edge of the mucosa; at some points however gland groups were seen in the base of the ulcer 10 to 12 millimeters from the mucosa. Most of the ulcer base was tumor free.

CASE 3. A woman, aged 57 years, complained of pains and cramps in the gastric region especially severe after meals. During her illness of 2 years, she had lost 24 kilograms. Test meal revealed free hydrochloric acid 32 total acidity 62. At laparotomy in the prepyloric region a tumor the size of a child's fist, freely movable, was detected. Along the lesser curvature there were several firm lymph glands. Resection of the stomach was performed. In the operative specimen on the lesser curvature just next to the pylorus there was a round, shallow terraced ulcer (Fig. 6) about 35 millimeters in diameter, with rolled in edges. The ulcer floor consisted of smooth, firm, whitish tissue. Cross section showed upward turning of the muscular coat. Six different blocks have been examined.

Histology. The ulcer consisted of a highly fibrous scar tissue heavily infiltrated with lymphocytes, eosinophils, and plasma cells covered with a thin, superficial layer of fibrinoid material. The muscular coat radiated at the ulcer edge as a compact strand into the ulcer floor. At the cardiac margin the muscularis mucosae and the muscular coat were fused. At the pyloric edge, the glands suddenly became very irregular and they invaded the deeper layers, having infiltrated also the submucosa as much as 10 to 15 millimeters beneath the normal mucosa. In all other blocks which presented essentially the same picture no transition could be observed; moreover, it was clearly discerned that the tumor invaded from below upward. Groups of irregular glands rapidly decreasing in size and

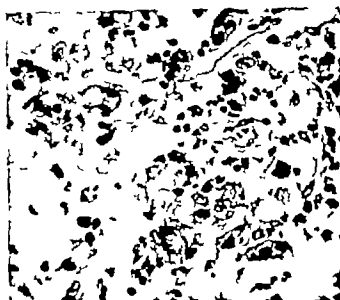


Fig. 11. Case 4. High power photomicrograph of rarefied area of Figure 10. $\times 495$

number toward the center were seen throughout the entire ulcer base. Under low power magnification there were, however entire fields free from cancer. In some sections in the depth of the ulcer base tubercle like formations were seen with many epithelioid and giant cells (Fig. 7). From the periphery they were being invaded by tumor tissue. No foreign body was seen within these nodules nor could acid fast bacilli be demonstrated.

CASE 4. A woman aged 62 years, complained of gastric distress after meals. This condition had been present for 20 years. For the past 2 years her condition had grown progressively worse. Within 7 months she had lost 12 kilograms in weight. Test meal yielded free hydrochloric acid 34 total acidity, 40. X-ray examination revealed a duodenal diverticulum and a rigid prepyloric area. At laparotomy the prepyloric area was found rigid and bulky. There



Fig. 12. Case 4. Frank adenocarcinoma at duodenal edge. $\times 26$



Fig. 13. Case 5. Early carcinoma near ulcer edge. $\times 20$.



Fig. 14. Case 5. The part outlined in Figure 13. $\times 115$.

were extensive adhesions to the mesocolon and the head of the pancreas. Resection of the stomach was done.

In the specimen removed (Fig. 8) a duodenal diverticulum was seen (arrow points to its entrance). At the lesser curvature 3 centimeters from the pylorus, there was a hemispherically depressed ulcer defect the size of a half walnut. Its floor and walls were smooth firm whitish. Joining it on the anterior stomach wall was a semicircular more superficial defect of the mucosa with hyperemic borders and a moderately firm, freshly digested floor. No enlarged lymph glands were present. In cross section upward turning of the muscular coat was observed. Seven blocks were removed for microscopic examination, as shown in Figure 8: 1 cardiac 2 duodenal 3 posterior 4 to 7 anterior stomach wall edge.

Histology. Block 3 presents a typical picture of chronic peptic ulcer with marked papillary hyperplasia of the mucosa (Fig. 9). In the highly fibrous ulcer base there were several vessels showing endarteritis. The muscular coat radiated into the ulcer floor. The muscularis mucosae and the muscular coat were closely approximated, almost fused. At first glance blocks 1 and 2 presented a similar picture except for an absence of papillary hyperplasia. At closer inspection however a peculiar change was seen within the mucosa (Fig. 10). In some places just at the ulcer margin, at other places somewhat farther from the margin quite small areas, 1 to 2 millimeters in diameter of decreased density were observed, showing loss of normal structure of the mucosa. Under high power magnification in an almost homogenous mass unstained both by hematoxylin and eosin but showing pink metachromasia with thionin stain, fragments of glands and scattered small groups of epithelial cells besides some round cell infiltration were seen (Fig. 11). Many of the scattered epithelial cells were vacuolar or actual signet ring cells, some of them had bursted and blended into the homogenous mass mentioned. At

the duodenal edge a narrow mass of free epithelial cells was seen advancing between the mucosa and the muscularis mucosae. Blocks 4 5 6 and 7 showed acute digestion of the superficial layers and a marked papillary hypertrophy of the mucosa. In the deeper layers typical gland groups of mucoid adenocarcinoma were present (Fig. 12), not farther however than about 3 to 4 millimeters from the ulcer margin. The entire ulcer base was tumor free.

As mentioned as far as we know this is the second known case of the nearly closed ring type of cancer secondary to ulcer.

CASE 5. A man aged 44 years, had typical ulcer anamnesis for 3 years. In the last year the pains had become almost constant and he had lost 23 kilograms in weight. Test meal yielded free hydrochloric acid, 70 total acidity 100. X-ray examination showed the typical ulcer deformity of the bulbous duodenum. At laparotomy a perforating ulcer was found on the posterior stomach wall just anterior to the pylorus. It was freed from the pancreas with considerable difficulty, the center of the ulcer base being left on the pancreas and cauterized. Then resection of the stomach was performed.

The specimen removed showed a typical callous ulcer 30 millimeters in diameter. In the center of its base there was a hole 10 millimeters in diameter. In cross section, upward turning of the muscular coat was seen. At the cardiac and the posterior wall edge there was a soft, white nodule the size of a pea, just beneath the mucosa. Six blocks were removed for histological examination.

Histology. The ulcer base consisted of a dense, cicatricial connective tissue, covered with a superficial necrotic layer. At the anterior edge of the ulcer wall the muscularis mucosae and the muscular coat were fused. Figures 13 and 14 present a most typical picture. Near the edge of the ulcer the glands become highly irregular and push deeply stained processes into the submucosa. The ulcer



Fig. 15. Case 6 Small adenocarcinoma embedded within the mucosa at the edge of the ulcer. $\times 37$



Fig. 16. Case 6 Irregular glands invading the submucosa. $\times 37$

base itself contained no atypical glands. All other blocks showed a broad zone of typical adenocarcinoma with medullary parts growing not farther than 5 millimeters into the ulcer base.

CASE 6. A woman, aged 46 years, complained of severe epigastric and right upper quadrant pains radiating into the shoulders, and frequent bilious vomiting of 1 year's duration. She had had a fair appetite and had not lost weight during her illness. At clinical examination only deep epigastric tenderness was found, no abnormal mass could be palpated in the abdomen. Test meal yielded free hydrochloric acid, 10 total acidity 28. X-ray examination of the digestive tract failed to disclose any abnormality. No visualization of the gall bladder could be obtained through intravenous dye administration. In spite of internal medication her complaints grew worse so laparotomy was performed. A rigid scar like mass was found on the lesser curvature near the pylorus. The distal half of the stomach was resected. In the operative specimen a prepyloric round ulcer about 30 millimeters in diameter was found. It had soft raised somewhat overhanging edges, especially at the cardiac edge. Its floor consisted of a smooth firm whitish tissue. In cross section the muscular coat was found to be turned upward. The mucosa showed marked redundancy and was whitish in color all around the ulcer margin except the pyloric edge where it looked like a common callous ulcer. Four blocks were removed for microscopical study.

Histology. The ulcer floor was formed by the granulation tissue becoming highly fibrous toward the depth and was covered by a superficial necrotic layer. In the connective tissue heavily infiltrated—chiefly by eosinophils—there were many large lymphatic nodules with well developed germinal centers. At the ulcer edge the muscular coat radiated into the ulcer base where it was lost. The muscularis mucosae and the muscular coat were separated by a rather broad band of cicatrized submucosa except at duodenal edge where they were approximated almost fused. No endarteritic vessels in base.

In the block taken from the pyloric edge just at the ulcer margin, a round area about 2 millimeters in diameter was embedded within the mucosa. It consisted of irregularly arranged glandular structures (Fig. 15). The glands were lined with 2 to 3 layers of epithelial cells showing marked polymorphism. The majority of the cells were dark with deeply stained nuclei, there were however parts where the cells were rather pale vacuolar. Very few mitotic figures were seen. No transition between this area and the normal mucosa was observed. About 5 millimeters from this area another quite similar nodule lay also entirely within the mucosa. In all other blocks the ulcer margin was formed by a broad zone very similar to the atypical glandular tissue described. At the cardiac edge many irregular glands invaded the submucosa (Fig. 16). In the other blocks the neoplasm did not penetrate the muscularis mucosae nor were glands anywhere encountered in the ulcer base. In some parts the tumor produced many papillary projections lined with 2 to 4 layers of epithelium showing moderate polymorphism. Other projections consisted merely of epithelium with connective tissue axis. The latter had a highly polymorphous epithelial covering with many mitotic figures. Parts of the neoplasm were necrotic and infiltrated with polynuclear leucocytes.

We consider this case a carcinoma arising from an adenomatous hyperplasia in the edge of a chronic gastric ulcer.

SUMMARY

We do not wish to draw conclusions from our statistics as our material is relatively small but we would like to call attention to the fact that cancer secondary to ulcer is not the rarity it is believed to be and taught by many authors. In 64 cases of chronic peptic

ulcer and 26 cases of carcinoma, we had 6 cancers secondary to ulcer. This fact justifies the opinion now held by the vast majority of prominent surgeons that whenever possible chronic gastric ulcers must be resected.

1. There are many discrepancies in the statistics as to the frequency of cancer developing on a peptic ulcer base.

2. Such cancers can be definitely diagnosed only by microscopic examination. Diagnosis is based on signs characteristic of chronic peptic ulcer and in addition there is found partial or complete freedom from cancer cells at the ulcer base and ulcer margin.

3. At the Third Surgical Clinic of the University of Budapest, in 64 cases of chronic gastric ulcer and 26 cases of carcinoma there were 6 cases in which cancer developed on an ulcer base.

4. Because carcinoma relatively frequently arises in peptic ulcer such ulcers should be resected whenever possible.

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CARCINOMA OF THE MALE BREAST

WITH SPECIAL REFERENCE TO ETIOLOGY¹

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THE purpose of this paper is to present a clinical and pathological study of 47 cases of male breast cancer with a summary of two postmortem reports. Forty-one cases are reported for the first time while 6 of the Memorial Hospital cases have been reported in part by Wainwright (Cases 1, 2, 3, 19, and 20) and Coley (Case 21). An attempt is made to correlate the etiological factors especially gynecomastia in male breast cancer with those of cancer of the breast in women.

The early history of the recognition of this disease is of interest. In the writings of Franciscus Arcaeus (1493-1573) we find the earliest reference, in that it is stated that cancer occurs also in males although not so frequently as in females. Fabricius Hildanus (1537-1619) described a single case of male breast cancer while Louis Heister, the famous German surgeon, described male mammary cancer at length in his inaugural dissertation. After reference to the publications of his time Morgagni (1682-1772) described several observations of his own regarding this disease. The frequently cited case of Thomas Bartholinus (1616-1682) probably refers to mammary cancer in a woman (Wolff).

About a century later the theses of Horteloup (1872) and of Poirier (1883) were the first to record systematic studies of this disease. Schuchardt followed Poirier a year later with two elaborate reports mostly from German and Austrian sources. The subject was first summarized in the English literature by Williams (1894) and Warfield who reviewed the known cases and added observations of their own. Recently Wainwright (1927) made an extensive review of the literature and added new material, he reported on 418 cases with an examination of the pathological material in 79.

Incidence At the Memorial Hospital, Pack and LeFevre found male breast cancer comprised 1.24 per cent or 0.41 per cent of all cancers in males. Deaver and McFarland found that 1.5 per cent of all mammary can-

cers occurred in men, while Schuchardt stated that of all malignant breast tumors about 2 per cent occurred in the male. According to several authors the percentage varies from 0.86 to 8.4, probably this latter figure is too high if a large series of cases of both sexes is carefully studied. The Census Bureau of England and Wales in 1926 reported on 5,339 mammary cancers of which only 0.08 per cent were in the male. Cancer of the male breast occurred only 9 times in 950 cases between the years 1889 to 1931 in the Johns Hopkins Hospital series.

ETIOLOGY

Heredity It appears that heredity is of secondary importance as a causative factor in male breast cancer. Several of the older patients who were foreign born made it impossible to ascertain an accurate history in regard to heredity and in the remaining cases no definite family history was obtainable. Four of Judd's 17 cases and 2 of 11 cases of Finsterer's series gave a positive history of cancer. Von Winniwarter considered heredity a causative factor in 5.8 per cent.

Sex factor Many explanations are given to account for the relative rarity of cancer of the breast in men as compared with women. The development of the gland is similar in both sexes until puberty. In the female, the course is then one of great functional activity and cyclic changes, whereas in the male the gland remains relatively stationary with less variation in the anatomical structure. The response to endocrine stimuli will be discussed later in the paper. However, this inherent difference in the function of the gland is the most commonly accepted explanation. The rare occurrence of cancer of the male breast is in accord with the general rule that cancer seldom arises in vestigial structures.

Age incidence It is a general opinion of observers since Poirier that cancer of the breast develops at a later age period in males than in females. It has been said that women



Fig. 3. Case 39. H. A. aged 50 years. Marked bilateral gynecomastia with cancer of the left breast. Clinical group, primary operable.

age earlier than men and it is a striking fact that 33 of 47 patients, or 70 per cent of this series were over 50 years of age. Wainwright found the average age to be 54.2 years in 401 cases. The oldest reported case was 91 years of age (Lunn) whereas the youngest patient was 12 years of age (Blodgett). The ages at the time of observations in cases in the present report are shown in Table I.

TABLE I—AGE INCIDENCE

| | Number of cases | Per cent |
|----------------|-----------------|----------|
| 30 to 39 years | 7 | 14 |
| 40 to 49 years | 7 | 14 |
| 50 to 59 years | 17 | 35 |
| 60 to 69 years | 8 | 25 |
| 70 to 79 years | 3 | 6 |
| 80 to 89 years | 1 | 2 |

Of 47 patients the oldest was an 83 year old negro while the youngest was 31 years of age. The average age of this group was



Fig. 3. Case 35. A. M. aged 54 years. Moderate hypertrophy of the right breast. The left breast is replaced by cancer. Clinical group, primary operable.



Fig. 5. Case 30. M. R., aged 57 years. Bilateral hypertrophy with cancer of the left breast. Clinical group, primary inoperable.

54.4 years whereas the mean age was 57 years.

Color. Two of the American born patients were negroes. Wainwright mentions that numerous cases of mammary cancer in negroes are reported by American surgeons but records no relative percentages. Lewis and Rienhoff report 3 negro patients in their series of 9 cases.

Side involved. The present series shows left breast involvement in 26 patients, the right breast in 20 and bilateral involvement in one patient. The predominance of the left side appears to coincide with the findings of various authors. Lane-Clayton in a recent statistical summary reported a slight left sided preponderance in women.

One patient, L. G. Case 32 had bilateral involvement. The primary tumor was

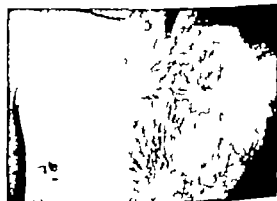


Fig. 4. Case 34. O. McN. Primary operable cancer of the right breast. Note the small disc-like mass with early ulceration.



Fig. 5. Photomicrograph showing the cell structure in Case 34. (See Fig. 4.) Alveolar carcinoma simplex, grade II, radioresistant.

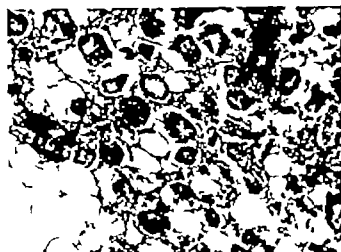


Fig. 6. Case 36. R. P. aged 56 years. Adenocarcinoma, grade II radioresistant. This patient presented moderately hypertrophied breasts.

noted in the left breast and removed surgically at another hospital. He was then referred to the Memorial Hospital for postoperative irradiation. One year later the patient developed a firm nodular mass beneath the nipple of the right breast, 2.5 by 2.5 by 1 centimeters in diameter associated with involvement of the axillary lymph glands.

Some observers have suggested that inasmuch as the majority of people are right handed the right side of the body might receive more trauma than the left—a theory not borne out by the facts if trauma is a cause. Wainwright in a total of 336 cases showed the right side involved 163 times, the left 170 times and in 3 patients both breasts.

Previously existing benign tumor. Three cases or 6.3 per cent in the present series gave a history of having a tumor removed from the breast prior to the onset of malignant growth. Only in the following case was the benign tumor re-examined in this laboratory. Patient 20 had a growth removed from the left breast diagnosed as sweat gland adenoma 15 years prior to the development of a painful mass in the same breast. On examination a small fixed tumor mass of the breast and several enlarged nodes were present in the axilla, as well as multiple skin nodules. A biopsy of the second tumor showed fibrocarcinoma simplex grade II.

We wish to stress the fact that any small localized swelling of the male breast with or

without classical signs of cancer should be considered as malignant until proved otherwise by microscopic examination. Patients who present themselves with disc or button like indurations beneath the nipple should have surgical removal performed at once.

Wainwright, in reporting the details of 5 cases of previously existing benign tumor with an alleged duration of from 20 to 24 years was able to study only 3 of the microscopic sections, but in none of these was histological confirmation of the existence of previous benign tumor obtained.

Schreiner believes that chronic inflammatory lesions often precede the development of a malignant tumor, and it is for this reason



Fig. 7. Case 33. E. K. aged 70 years. Fibrocarcinoma simplex, grade II radioresistant.

that benign tumors in the male breast are treated by radical amputation. Other observers are less radical and believe that local mastectomy followed by irradiation treatment will control cancer of the male breast.

Trauma. Previous history of injury was obtained in 14 or 19 per cent of the cases in this series. A single severe injury was reported in 12 of the 14 cases, while 2 patients were accustomed to exert pressure against the chest wall while following their usual trades. It should be noted that in all these cases the previous integrity of the breast and the authenticity and sufficiency of the trauma rest entirely upon the statements of the patients and were not verified. That the tumors arose at the exact point of the injury was also not determined.

It is important to obtain a critical history of the sequence of events in those instances in which a single severe trauma is apparently followed by the development of cancer. Ewing clearly states the factors which should be observed in making a positive judgment of the relationship of trauma to breast tumors. He insists that such relationship may be assumed to have causal significance only if the breast can be shown to have been previously normal and the injury to have been severe enough to have caused interstitial hemorrhage and solution of continuity of the breast ducts also that there must be some indication of continuity of symptoms between the trauma and the appearance of the tumor and that even in those cases one can only maintain a probable relationship.

Knox also warns us that it would be as inaccurate and unscientific to ascribe the origin of a cancer to a single blow as it would be to judge the duration of a tumor of the breast from the patient's statements.

Murphy on the other hand makes a radical statement that the breast is the only organ in the body where cancer will develop following a single mild trauma. Concerning the influence of trauma, reports in the literature vary greatly. Schuchardt considered 25 of his 219 cases due to contusion or mechanical causes. In only one of Judd's series of 17 cases was trauma mentioned as a possible causative factor. Wainwright reports the re-

lationship so frequently that he feels it must be taken into consideration as a cause of cancer at least in the male breast.

Gynecomastia. While the observation of cancer with gynecomastia has been noted in occasional case reports, it has not been sufficiently emphasized. Ewing states that unusual development and activity of the breast are predisposing conditions for cancer of the male breast.

Pertinent facts in regard to the complex hormonal control of breast development by means of pituitary thyroid prostatic, and testicular secretions may be summarized as follows:

Experimental evidence. Two types of experimental procedure—organ transplantation and the use of organ extracts—have been used to show the relation of the ovary to new development of the mammary gland. Athias and later Steinach were able to produce breast growth even in male guinea pigs by the implantation of ovaries. Ferguson and others have demonstrated that following daily injections of prolactin in laboratory animals over long periods of time an epithelial hyperplasia of the prostate is noted. An imbalance between the testis and pituitary must account for the production of a small relative increase in the pituitary secretion which acts directly upon the prostate and indirectly upon mammary tissue. Furthermore, if the testes are removed, atrophy of the prostate follows showing that the pituitary substance must act through the testes. Loeb points out that with regard to the arrested growth of the mammary gland it is possible that the developing testis may exert a certain inhibiting effect.

Clinical evidence. Taylor showed by clinical observations that the breast epithelium of the female is normally responsive throughout life to stimulation by the internal secretion of the ovary. The literature is replete with instances of gynecomastia associated with imperfect development of the male sexual organs, such as pseudohermaphroditism, after atrophy and removal of the testes, and associated with malignant testicular tumors. We have observed the association of excessive secretion of prolactin in the urine of patients with teratoma testis associated with gynecomastia.

Typical gynecomastic breasts were noted in 5 such patients and even breast secretion in one instance. At autopsy an excessive proliferation of the epithelium of the prostate was also regularly observed.

In patient 23 there was disclosed at autopsy a persistent thyroglossal duct and bilaterally undescended fetal testes. These fetal abnormalities involving the thyroid and the testes were possible sources of endocrine imbalance in this patient. A young man was recently observed at this hospital presenting gynecomastic breasts as well as typical evidence of exophthalmic goiter. Many patients with gynecomastia reported in the literature have had other endocrine disorders which might influence the testis and thus be indirectly related to hypertrophy of the male breast.

Co-existent gynecomastia with cancer. Mammary hypertrophy has been studied by Pigot, Schuchardt, Berns, Imbert and Villeon who report cases of concurrent cancer and gynecomastia. Imbert and Collignon strongly considered gynecomastia as an etiological factor in certain cases of cancer of the breast.

Berns reports an unusual case from the standpoint of the size of the hypertrophied breast. A 42 year old man stated that since youth both breasts had been enlarged. He recalled a blow to the right breast received in childhood and followed by acute pain for several days. No secretion from the breast was ever noted. He sought consultation in September 1884 because of a small tumor of long duration in the right breast. Both breasts were extraordinarily developed resembling the female type pendulous and containing fatty tissue. The horizontal diameter of the left breast was 17 centimeters and of the right 19.5 centimeters. The vertical diameter of the left breast was 14 centimeters, and of the right 16 centimeters. The right breast was the seat of an oval tumor 6 by 9 centimeters in diameter located about 2 centimeters from the nipple. The mass was freely movable over the pectoral muscles and no involvement of the axillary gland was noted. The right breast as well as the normal left breast were surgically removed in November 1884. A second operation was done for local

recurrence in May 1885 and another local recurrence was removed a year later. The patient died in May, 1886 with signs of pulmonary edema (metastasis?). Microscopic examination of the breast tumor revealed an alveolar scirrhous cancer of the breast.

Villeon's case demonstrated the not uncommon occurrence of gynecomastia associated with benign tumor of the prostate with a later development of cancer in one breast. A 75 year old man was operated on 12 years previously for benign hypertrophy of the prostate. Following this operation he developed bilateral gynecomastic breasts which were the type and shape of the female gland. Later a typical cancer of the right breast developed with nipple retraction and axillary gland involvement. Five years after mastectomy local recurrence was noted which was treated by roentgen therapy. The microscopical diagnosis of the breast tumor was epithelioma.

Anatomical evidence. That the male breast contains abundant glandular tissue and not merely adipose tissue as was previously supposed has been demonstrated by Bailey, Andrews and Kampmeier and more recently by von Guernar. He examined 106 male breasts at various ages and found in gynecomastia that the connective tissue is only slightly increased while the glandular tissue shows a marked hyperplasia, and concluded that such breasts are more liable to be the seat of cancer. Wainwright (p. 843) shows a large cross section of such a gland and states that it is a frequent type in his experience. Hinze removed a hypertrophied breast weighing 125 grams which showed areas of glandular tissue on microscopical examination.

Summary of present series of gynecomastic cases. We have observed 9 patients, or 19 per cent of the entire series, who presented hypertrophied mammary glands corresponding in general topography to the female breast. All of this group were white and ranged from 37 to 73 years. The left breast was involved with cancer 6 times and the right breast, 3 times. Trauma was mentioned in the antecedent history only 4 times.

The shortest duration of the existence of the tumor before examination at the clinic

was 3 months, while the longest interval was 48 months. Pain was noted twice bleeding once, nipple retraction 9 times and ulceration 9 times. For clinical grouping the patients were classified as primary operable, 3 primary inoperable 5 and recurrent inoperable 1. The disease was markedly advanced in the majority 66 per cent being inoperable on admission.

The types of cancer observed were adenocarcinoma, 4 duct carcinoma 2 and carcinoma (punch aspiration) 2. The re-examination of tissue was not possible in one instance. Of 5 sections available for grading 4 were grade II and 1 was grade I. Corresponding to the clinical grouping metastases were distributed as follows axilla 8 supraclavicular 6 lungs 4 and bones, 1.

Surgical procedures were carried out in 5 patients. Local and radical mastectomy were each performed twice and in one other patient gold radon tubes were implanted in the tumor.

Five patients are dead while 2 are alive with evidence of cancer. Two are alive with out evidence of disease 11 months and 18 months, respectively from the time of first observation.

SYMPTOMATOLOGY

Such symptoms as pain, bloody discharge from and retraction of the nipple varied according to the extent of the disease and the histological structure of the tumor.

In all cases the patient noted the presence of a tumor mass. In 14 patients the tumor mass was the first sign to call attention to the disease. The majority of the tumors were in the region of the nipple, which agrees with observations made by Speed, who reported that in 50 per cent of his cases the nipple becomes involved. Because of incomplete histories and the number of recurrent cases treated in this series it is impossible to determine the quadrant originally involved.

Other symptoms were noted as follows pain 13 times or 27 per cent bleeding 4 times or 8 per cent nipple retraction 14 times or 29 per cent and ulceration 14 times or 29 per cent. Figure 4 shows the type of ulceration found with a relatively small

tumor mass. Extensive ulceration is common since the growth is near the skin and extends to involve it by direct continuity. Fourteen patients gave a history of previous scab formation or ulcerations. Ulceration seemed to bear no relation to the duration or the size of the tumor. It is common and tends to appear early. Ulceration occurred in all types of tumors of the male breast observed in this study and yet no instances of typical Paget's disease or sweat gland cancer which in the female breast are commonly associated with early ulceration, were seen.

Clinical classification. Of the total series the patients were classified on admission as follows Primary operable 18 primary inoperable 10 and recurrent inoperable 19. Twenty nine patients, or 61 per cent, were inoperable.

PATHOLOGY

In any consideration of the normal histology of the male breast the fact that glandular tissue is consistently noted is of importance in the physiology and pathology of this organ. Bailey at the London Hospital upon examination of male breasts of postmortem subjects between the ages of 6 months and 65 years, found glandular tissue present in all cases. Andrews and Kampmeier found a complete series of ducts and alveoli in every male breast examined. Their description is quoted in detail since the histology of this organ is given but scanty attention in most textbooks of anatomy. The ducts are lined by a single layer of columnar epithelium and are invariably patent. They lie imbedded in rather dense connective tissue. The capsule is not sharply defined and blends with the adjacent fibrous tissue. There is a rather sharply differentiated periductal tissue which consists of less deeply staining fibers containing a greater number of nuclei. This periductal zone bears a close resemblance to growing tissue and has been mistaken for proliferating fibrous tissue. Investigations show that probably in the majority of adult males, the breast persists in essentially the same state as in the pre-adolescent female, and there exists in the male breast a complicated system of open ducts which are far from being vestigial in nature.

Forty-one tumors available for re-examination were classified by Ewing as in Table II

TABLE II—EWING'S CLASSIFICATION
OF 41 TUMORS

| Type of tumor | Cases |
|------------------------------|-------|
| Carcinoma simplex | 25 |
| Adenocarcinoma | 9 |
| Scirrhus (fibro) carcinoma | 2 |
| Epithelioma | 1 |
| Carcinoma (punch aspiration) | 5 |
| No tissue | 5 |

Thirty two sections were graded as follows

| Grade (differentiation) | Cases |
|-------------------------|-------|
| Grade I | 1 |
| Grade II | 24 |
| Grade III | 7 |
| Not graded | 15 |

Twenty five of 42 sections, or 59 per cent, available for review were classified as carcinoma simplex. Wainwright found that carcinoma simplex is less common in men reporting only 3.7 per cent in his series of 78 cases, but Warfield, on the other hand agreed with the findings in the present series that carcinoma simplex was the histological diagnosis most frequently made.

With one exception all tumors classified as carcinoma simplex were grade II and radioresistant. The remaining case was a very cellular grade III radiosensitive tumor. There were no grade I tumors in this group. Of the whole series only one tumor was of grade I degree of differentiation while 7 or 21 per cent, were grade III. While a determination of the degree of radiosensitivity is a difficult problem in 18 of 20 sections diagnosed as probably radioresistant, the clinical course after thorough irradiation proved fatal. In one patient, Case 29, a cellular carcinoma simplex, grade III radiosensitive, entirely disappeared following one cycle of X-ray therapy.

A striking comparison between Greenough's group of women compared with an almost equal group of men studied by Wainwright shows that in both groups the number of cases in each assigned to the low and high malignancy classes is practically equal.

A summary of the 4 cases in the high group (grade III) is of interest.

CASE 37 B. H. had noted a tumor mass 18 months previous to admission. He died 4 months following

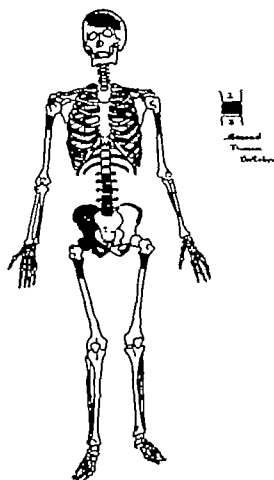


Fig. 8. Case 30 S. R., aged 31 years. Negro. Recurrent inoperable cancer of the left breast. Diffuse bone involvement indicated by shaded areas. Pathological fractures of the left humerus and of the right femur. Total duration of disease 5 years and 2 months.

first observation making a total duration of the disease 22 months following the first symptoms.

CASE 44 M. S. had noted a mass in the left breast 18 months previous to admission. He lived 2 months following first observation in the clinic making a total duration of the disease of 20 months.

CASE 41 O. K. had noted a mass in the left breast 8 months previous to admission. He lived 15 months following first observation making a total duration of the disease 23 months.

CASE 30 S. R. had noted a mass in the left breast late in 1919. A radical mastectomy was performed in August, 1923 at another hospital. Because of pain in the right lumbar region he was referred to the Memorial Hospital for diagnosis and treatment. His condition at time of death was one of extensive involvement of practically all the long bones of the body with pathological fractures of the left humerus and the right femur. The right innominate bone was practically replaced by cancer (Fig. 8). He was transferred to the United States Marine Hospital where he died May 1925 making a total duration of life from the onset 6 years and 3 months.

TABLE III.—SUMMARY OF EIGHT CASES TREATED BY IRRADIATION ONLY

| Case No. | Age | Clinical group | End result | Length of life following first irradiation |
|-----------------|-----|--------------------|--|--|
| L. ^W | 70 | Primary operable | Alive 7-30-33 without disease | 11 mos. |
| C. ^L | 6 | Primary inoperable | Alive -71-33 with disease | 9 mos. |
| W. ^C | 68 | Primary inoperable | Dead 7-22-33 with axillary supraclavicular and lung metastases | 7 mos. |
| J. ^D | 53 | Primary operable | Dead 7-4-33 of cerebral hemorrhage | 6 mos. |
| A. ^M | 54 | Primary operable | Dead 6-9-37—Size and bilateral axillary metastases | 3 mos. |
| H. ^A | 70 | Primary inoperable | Dead 2-20-30—Axillary and supraclavicular metastases | 7 mos. |
| F. ^L | 54 | Primary inoperable | Dead 4-13-32—Bilateral axillary and pulmonary metastases | 5 mos. |
| M. ^H | 55 | Primary inoperable | Dead 2-13-36—Metastases to skull, supraclavicular, lungs, legs and bones | 14 mos. |

Summary of two cases with autopsy findings

CASE 22 J. A. K. age 65 white married Jewish. Family history negative, past history negative. The patient was struck by the corner of a mall car rack in 1915 at the upper outer quadrant of the right breast. In 1916 he noted a small mass at the site of the alleged injury. Local medication failed and mass increased to the size of a quarter. The tumor showed moderate fixation to the chest wall with evidence of right axillary and right supraclavicular metastases. The left breast and axilla were normal.

Radical mastectomy was performed July 13, 1917. The microscopic diagnosis was adenocarcinoma, grade II radioresistant. A chest plate May 14, 1923 showed evidence of bilateral pulmonary metastases. One month later he fell unconscious and thereafter vomited practically everything taken by mouth. A fluoroscopic examination of the stomach at another hospital was reported negative. He was admitted to Memorial Hospital July 15, 1924, in extremely poor condition, rapidly lost weight and strength and died August 18, 1924, 8 years from the onset of the first symptom.

Microscopic diagnosis of autopsy material lungs, cellular alveolar carcinoma axillary nodes, free stomach and liver, carcinoma resembling the primary tumor of the breast.

CASE 23 E. K. age 79 single white, Bohemian. Family and past history are not contributory. About 3 years ago the patient was struck in the region of the left nipple by a piece of wood splinter but no bleeding followed this injury. Three months after the trauma he noted a small ulcer in the region of the left nipple which gradually spread over the entire breast area and became infected. He did not consult a physician for 2 years, during which time he developed marked swelling of the arm and numerous skin nodules over the entire thorax. For the

last 3 months he had lost strength and developed some cough but no hemoptosis.

On examination the patient appeared very weak with evident loss of weight. An ulcerated lesion over the region of the left breast consisted of an irregular area about 6 centimeters in diameter with raised and indurated edges. There was marked non-specific elephantiasis of the left arm. Several hard nodes in the supraclavicular area were noted and the body was covered with numerous subcutaneous nodules varying from 1 to 2 centimeters in diameter. A biopsy December 16, 1927 showed carcinoma simplex grade II, radioresistant. A diagnosis was made of primary inoperable cancer of the left breast with axillary supraclavicular, and skin metastases, and probably also pulmonary involvement.

He was admitted to the Montefiore Hospital January 11, 1928 in extremis and died suddenly the following day. At autopsy the left breast was found to be the seat of a tumor mass with numerous metastases to the skin, lungs, bronchial, axillary, inguinal, and retroperitoneal lymph nodes, thrombosis of the axillary veins with marked non-specific elephantiasis of the left upper extremity, chronic passive congestion of the liver, persistent thyroglossal stalk and bilaterally undescended fetal testes, generalized atherosclerosis and arteriosclerosis of the kidneys, organized thrombosis of deep femoral arteries, bronchopneumonia of the left lower lobe, and acute splenic enlargement. The development of non-specific elephantiasis of the left arm without previous operative procedure is to be noted. The autopsy findings of a persistent thyroglossal stalk and bilaterally undescended testes is significant as a possible etiological factor.

Multiple tumors. A single instance of multiple tumor occurred in Case 33, a 43 year old man who presented a recurrent inoperable

cancer of the right breast, as well as multiple lipomata of the extensor surface of the right forearm, the left upper arm, and of the skin of the chest wall

METASTASES

All patients known to be dead or lost to record showed clinical or X ray evidence of metastases usually multiple and widespread. Of 16 patients alive at time of present report, 9 have no evidence of recurrence or metastatic disease, however, only 3 of the 9 patients were observed before January, 1928. Axillary lymph nodes were involved in 10 of 23 patients at the time of radical operation. The distribution of metastases was as follows: skin, 8, axilla, 30 (4 times bilateral), supraclavicular fossa, 17 (1 case bilateral), lungs, 21 bones, 5.

TREATMENT

Surgical. Thirty-eight or 80 per cent of the series had some surgical procedure while only 9 patients were treated by other methods. One patient had a local removal of the primary tumor in another hospital followed by radical mastectomy here. Radical mastectomy was performed 24 times, local mastectomy 8 times, and local removal of the tumor 6 times. As a majority of these patients received some form of irradiation therapy, the end results will be discussed in one group.

Fourteen of Judd's 17 cases were treated by radical amputation. Wainwright showed that nearly half of the men apply for treatment during the first 12 months, in spite of these figures, which compare favorably with statistics of a similar kind in breast cancer in women, there is considerable delay between the onset of the disease and surgical or irradiation treatment. Various reasons are given to explain this apparent neglect. That the male often does not consider himself liable to cancer of the breast, and therefore has much less fear of the disease is perhaps the principal cause for the delay. In many instances when a small freely movable tumor is brought to the physician's attention, the condition is not given serious consideration until typical signs of cancer appear. Cancer of the male breast should be treated on the same prin-

ciples as in the female. Biopsies should be taken for frozen section diagnosis if there is any uncertainty concerning the true nature of the disease. That these tumors are often small does not justify limited removal and operative procedures should be radical regardless of the desire to avoid impairment of arm function.

Five patients or 10 per cent of this series developed non specific elephantiasis of the arm. Treves discussed this complication as seen with cancer of the breast in women, and his conclusions in regard to the management of these patients applies equally to the male breast cases. None of our patients received surgical treatment for this condition.

Radiation. All 16 patients under present observation have received some form of irradiation treatment, while 23 of 28 patients now dead were so treated. These patients were treated by a variety of methods, and for that reason an evaluation of end results in this group is without definite value. The technique varied from a single exposure of low voltage, unfiltered X rays to repeated courses of treatment with both the radium element pack and high voltage X rays up to full erythema dosage.

The cases under present report have been treated over a period of many years. In the earlier years we had nothing but low voltage X ray, and the dosage could not be checked with accurate measurements now available. Such treatments delivered to the tumor only a fraction of an erythema which we know now was inadequate to destroy breast cancer. With our present knowledge such patients classified according to their clinical status and

TABLE IV

| Case No. | Age on admission | Date of mastectomy | Type and grade of tumor | Last note | Survival period |
|----------|------------------|----------------------|------------------------------------|-------------------------------|-------------------|
| G. L. | 57 | 5-2-10 Radical | Carcinoma scirrhous, grade II | 5-22-1930 free of disease | 7 yrs. 3 mos. |
| F. A. | 74 | 8-5-10 Local | Fibrocarcinoma scirrhous, grade II | 8-30-1933 free of disease | 6 yrs. 11 mos. |
| S. A. | 66 | 9-22-1921 Radical | Cellular adenocarcinoma, grade II | 11-18-1928 free of disease | 6 yrs. 8 mos. |

TABLE V.—ANALYSIS OF FORTY-SEVEN CASES OF CANCER OF

| Case No. | Date of admission | Age | Color | Side involved | Clinical group | Thromb. staged | Gynec. metast. | Type of tumor | At operation— Axi- illary nodes involved | Grade of malignancy | Metastases | | | | |
|----------|-------------------|-----|-------|---------------|----------------------|----------------|----------------|--------------------------------|---|---------------------|------------|---------|------------------------|-------|-------|
| | | | | | | | | | | | Skln | Arteria | Supra-clavicular nodes | Lungs | Bones |
| G. E. | 8-22 | 57 | White | Left | Primary operable | None | None | Carcinoma simplex | None | II | None | None | None | None | None |
| F. A. | 9-4-27 | 74 | White | Right | Primary operable | None | None | Fibrous carcinoma simplex | None | II | None | None | None | None | None |
| S. A. | 7-2-21 | 64 | White | Right | Primary operable | Yes | None | Cellular adenocarcinoma | None | II | None | None | None | None | None |
| A. D. | 4-2-29 | 52 | White | Left | Recurrent inoperable | None | None | Carcinoma simplex | None | II | Yes | None | None | None | None |
| W. C. | 7-7-20 | 5 | White | Right | Primary operable | Yes | None | Tubulo-alveolar carcinoma | None | II | None | None | None | None | None |
| S. B. | 7-10-20 | 45 | White | Left | Primary operable | None | Yes | Small cell duct carcinoma | Yes | II | None | Yes | None | Yes | None |
| J. W. | 10-20-20 | 42 | White | Right | Primary operable | Yes | None | Carcinoma simplex | None | II | None | None | None | None | None |
| R. M. | 7-6-21 | 28 | White | Left | Recurrent inoperable | None | None | Adenocarcinoma | None | II | Yes | None | None | Yes | None |
| L. W. | 8-17-21 | 30 | White | Left | Primary operable | Yes | Yes | Carcinoma (apoptosis) | None | Not graded | None | Yes | None | None | None |
| H. F. | 6-7-21 | 73 | White | Right | Primary operable | Yes | Yes | Duct carcinoma | None | II | None | None | None | None | None |
| E. A. | 6-4-21 | 38 | White | Right | Primary operable | None | None | Papillary adenocarcinoma | None | I | None | None | None | None | None |
| S. C. | 7-7-21 | 22 | White | Left | Recurrent inoperable | None | None | Carcinoma simplex | Yes | II | Yes | Yes | None | Yes | Yes |
| E. G. | 7-23-21 | 61 | White | Right | Primary operable | None | None | Duct carcinoma | Yes | III | None | None | None | None | None |
| C. K. | 5-7-21 | 60 | White | Left | Recurrent inoperable | None | None | Infiltrating carcinoma simplex | Yes | III | None | Yes | None | None | None |
| C. K. | 7-27-21 | 61 | White | Right | Primary operable | None | Yes | Adenocarcinoma | None | II | None | Yes | Yes | None | None |
| A. G. | 9-19-20 | 58 | White | Left | Primary operable | None | None | Basal cell epithelioma | None | Not graded | None | None | None | None | None |
| J. W. | 6-12-21 | 43 | White | Right | Recurrent inoperable | None | None | None | None | None | None | Yes | Yes | Yes | Yes |
| W. C. | 8-1-21 | 68 | White | Right | Primary operable | None | None | Carcinoma (apoptosis) | None | Not graded | None | Yes | Yes | Yes | None |
| J. W. | 9-15-21 | 1 | White | Left | Recurrent inoperable | Yes | None | Adenocarcinoma | None | Not graded | Yes | Yes | None | Yes | None |
| M. R. | 7-20-21 | 37 | White | Left | Primary operable | None | Yes | Adenocarcinoma | None | III | None | Yes | Yes | None | None |
| C. B. | 11-20-21 | 61 | White | Right | Recurrent inoperable | None | None | Adenocarcinoma | None | III | None | None | None | Yes | None |
| J. K. | 9-20-21 | 45 | White | Right | Recurrent inoperable | Yes | None | Adenocarcinoma | None | II | Yes | None | None | Yes | None |
| R. K. | 9-16-21 | 79 | White | Left | Primary operable | Yes | None | Carcinoma simplex | None | II | Yes | Yes | Yes | Yes | None |
| S. R. | 7-18-21 | 25 | White | Left | Primary operable | Yes | None | Infiltrating duct carcinoma | None | II | None | Yes | None | Yes | None |
| M. R. | 7-18-21 | 23 | White | Left | Primary operable | None | None | Fibrosarcoma | None | II | None | Yes | None | Yes | Yes |

THE MALE BREAST OBSERVED AT THE MEMORIAL HOSPITAL

| Previous benign tumor | Previous duration in months | Symptomatology | | | | Operation | Post operative recurrence | Emphascism | Irradiation treatment | Last note | Five year survival |
|-----------------------|-----------------------------|----------------|----------|-------------------|------------|----------------------------|---------------------------|------------|-----------------------|---------------------------------|--------------------|
| | | Pain | Bleeding | Nipple retraction | Ulceration | | | | | | |
| None | 0 | Yes | None | None | None | 2-3-23 radical | None | None | Yes | 2-11-30 alive N.E.D. | Yes |
| None | 1 | None | None | None | Yes | 0-9-25 local | None | None | Yes | 8-10-32 alive N.E.D. | Yes |
| None | 48 | Yes | None | None | None | 0-21-31 radical | None | None | Yes | 1-2-30 alive N.E.D. | Yes |
| None | 7 | None | None | None | None | 2-30-28 radical | Yes | None | Yes | 7-24-32 alive N.E.D. | N |
| None | 2 | None | None | None | None | 7-8-30 radical | None | None | Yes | 2-10-32 alive N.E.D. | No |
| None | 12 | Yes | None | Yes | None | 7-1-30 radical | None | None | Yes | 1-2-32 Metastasis, lungs | N |
| None | 54 | None | None | None | Yes | 10-17-30 radical | None | None | Yes | 7-17-31 alive N.E.D. | No |
| None | 18 | None | None | None | Yes | 1-30-30 radical | Yes | None | Yes | 7-30-32 Metastasis, chest | N |
| None | 4 | None | None | Yes | None | None | None | None | Yes | 7-30-32 alive N.E.D. | No |
| None | 6 | None | None | Yes | Yes | 6-2-31 local | None | None | Yes | 12-3-32 alive N.E.D. | No |
| None | 5 | None | Yes | None | None | 7-6-32 local | None | None | Yes | 0-20-32 alive N.E.D. | No |
| Yes | 14 | None | None | None | Yes | 0-10-30 radical | Yes | None | Yes | 1-21-32 alive—pelvic recurrence | No |
| None | 1 | None | None | Yes | Yes | 4-1-32 radical | None | None | Yes | 7-14-32 alive N.E.D. | N |
| None | 20 | None | None | None | None | 5-4-32 axillary dissection | Yes | None | Yes | 1-11-32 alive N.E.D. | No |
| None | 8 | None | Yes | Yes | Yes | None | None | None | Yes | 1-22-32 alive with recurrence | No |
| None | 1 | None | None | None | None | 0-2-32 local | None | None | None | 0-31-32 alive N.E.D. | N |
| None | 8 | None | None | None | None | 7-11-31 radical | Yes | None | Yes | Died 4-2-32 | N |
| None | 48 | None | None | Yes | Yes | None | None | Yes | Yes | Died 2-22-32 | N |
| None | 4 | Yes | None | None | None | 0-17-30 radical | Yes | None | Yes | Died 8-9-32 | Yes |
| None | | None | None | Yes | Yes | 3-3-32 local | None | None | Yes | Probably died 3-8-32 | No |
| Yes | 7 | None | None | None | None | 4-23-32 radical | Yes | None | Yes | Died 2-15-30 | No |
| None | 30 | None | None | None | None | 7-1-31 radical | Yes | None | Yes | Died 8-10-32 | No |
| None | 36 | None | Yes | Yes | Yes | None | None | Yes | None | Died 2-22-32 | N |
| None | 13 | None | None | Yes | Yes | 2-10-30 radical | Yes | None | Yes | Died 2-21-32 | No |
| None | 6 | Yes | None | None | None | 5-17-31 local | Yes | None | Yes | Died 12-10-32 | Yes |

TABLE V—ANALYSIS OF FORTY-SEVEN CASES OF CANCER OF THE

| Case No. | Date of admission | Age | Color | Side involved | Clinical group | Thyroid enlarged | Gynecological metastasis | Type of tumor | At operation: Adjuvant therapy received | Grade of malignancy | Metastases | | | | |
|----------|-------------------------------|-----|-------|---------------|----------------------|------------------|--------------------------|----------------------------|---|---------------------|------------|-----------|------------------------|-------|-------|
| | | | | | | | | | | | Skin | Blood | Supra-clavicular fossa | Lungs | Bones |
| 16 J B | 2-25-28 | 53 | White | Left | Recurrent inoperable | None | None | Carcinoma simplex | None | II | None | None | Yes | Yes | None |
| 27 A C | Not known (see case 6-2-3-28) | 53 | White | Left | Recurrent inoperable | None | None | Fibrosarcoma simplex | None | II | Yes | Bilateral | Bilateral | None | None |
| 28 C M | 2-2-29 | 6 | White | Left | Primary operable | Yes | None | Urethral carcinoma | Yes | II | None | Yes | None | Yes | None |
| 29 J D | 2-8-28 | 83 | Black | Right | Primary operable | None | None | Carcinoma simplex | None | III | None | Yes | None | Yes | None |
| 30 S R | 2-1-28 | 41 | Black | Left | Recurrent inoperable | None | None | Carcinoma | Yes | Not graded | None | None | None | None | Yes |
| 31 B D | 6-5-28 | 26 | White | Right | Recurrent inoperable | None | Yes | Carcinoma | Yes | Not graded | None | Yes | Yes | Yes | None |
| 32 L G | 8-1-28 | 40 | White | Bilateral | Recurrent inoperable | None | None | Breast carcinoma | Yes | Not graded | None | Bilateral | Yes | None | None |
| 33 A K | 2-2-28 | 26 | White | Right | Recurrent inoperable | Yes | None | Carcinoma simplex | Yes | III | None | Yes | None | None | None |
| 34 M V | 2-2-27 | 3 | White | Right | Primary operable | None | None | Alveolar carcinoma simplex | None | II | None | Yes | None | Yes | None |
| 35 A M | 6-2-28 | 54 | White | Left | Primary operable | None | None | None | None | None | Yes | Bilateral | None | None | None |
| 36 R P | 2-2-27 | 58 | White | Left | Primary inoperable | Yes | Yes | Fibro-adenocarcinoma | None | II | None | Yes | Yes | Yes | None |
| 37 H H | 2-2-28 | 65 | White | Left | Recurrent inoperable | None | None | Carcinoma simplex | None | III | None | Yes | Yes | Yes | None |
| 38 J C | 2-2-28 | 6 | White | Right | Recurrent inoperable | None | None | Carcinoma simplex | None | II | None | Yes | Yes | None | None |
| 39 H A | 6-1-28 | 26 | White | Left | Primary inoperable | Yes | Yes | None | None | None | None | Yes | Yes | None | None |
| 40 F S | 2-2-28 | 59 | White | Left | Primary operable | Yes | None | Carcinoma simplex | Yes | II | Yes | Yes | None | Yes | None |
| 41 O K | 2-2-28 | 44 | White | Left | Primary inoperable | None | None | Alveolar carcinoma | Yes | II | None | Yes | None | Yes | None |
| 42 T M L | 2-2-28 | 42 | White | Left | Recurrent inoperable | None | None | None | None | Not graded | None | Yes | Yes | Yes | None |
| 43 B G | 2-2-28 | 54 | White | Right | Recurrent inoperable | None | None | Carcinoma simplex | None | II | None | Yes | None | None | Yes |
| 44 M B | 6-6-28 | 40 | White | Left | Recurrent inoperable | None | None | Alveolar carcinoma | Yes | II | None | None | Yes | Yes | None |
| 45 F S | 2-2-28 | 34 | White | Right | Primary inoperable | None | None | None | None | None | None | Bilateral | None | Yes | None |
| 46 M S | 2-2-28 | 45 | White | Left | Primary inoperable | None | Yes | Adenocarcinoma | None | Not graded | None | Yes | Yes | Yes | Yes |
| 47 E K | 2-2-28 | 68 | White | Right | Primary operable | None | None | Carcinoma (simplex) | None | Not graded | None | None | None | Yes | None |

Abbreviations: N.E.D. indicates "no evidence of disease"

MALE BREAST OBSERVED AT THE MEMORIAL HOSPITAL—Continued

| Previous benign tumor | Previous duration in months | Symptomatology | | | | Operation | Post operative recurrence | Elephant-tusk | Irradiation treatment | Last note | Five year survival |
|-----------------------|-----------------------------|----------------|----------|-------------------|------------|--------------------------------------|---------------------------|---------------|-----------------------|-----------------------|--------------------|
| | | Pain | Bleeding | Nipple retraction | Ulceration | | | | | | |
| Yes | 24 | None | None | None | None | 9 d. local removal | Yes | Yes | Yes | Died 1-20-30 | No |
| Yes | 2 | None | None | None | None | 1913 axillary dissection | Yes | None | None | Died 8-9-38 | No |
| None | 14 | Yes | None | None | None | 8-15-30 radical | None | None | Yes | Died 8-16-30 | No |
| None | 2 | None | Yes | None | None | None | None | None | Yes | Died 7-14-18 | No |
| None | 48 | None | None | None | None | 8-18-13 radical | Yes | None | Yes | Died 8-23-25 | N |
| None | 48 | None | None | Yes | None | 8-19-26 radical | Yes | None | Yes | Died 1-14-30 | No |
| None | 1 | None | None | None | None | 8-21-8 radical | Yes | Yes | None | Probably died 4-20-30 | No |
| None | 20 | Yes | None | None | None | 4-25 local | Yes | None | Yes | Died 1-19-30 | No |
| None | 16 | None | None | None | None | 4-19-27 radical | None | None | Yes | Died 2-9-27 | No |
| None | 20 | Yes | None | None | Yes | None | None | None | Yes | Died 6-2-27 | N |
| None | 1 | None | None | Yes | Yes | None | None | None | Yes | Died 6-12-28 | No |
| None | 6 | Yes | None | None | Yes | 0-9-17 local | Yes | None | Yes | Died 2-9-18 | No |
| None | 2 | None | None | None | None | 4-11-18 local | Yes | Yes | None | Died 2-10-20 | N |
| None | 26 | Yes | None | Yes | Yes | None | None | None | Yes | Died 1-29-20 | No |
| None | 7 | None | None | None | None | 1-20 radical | None | None | Yes | Died 8-25-2 | No |
| None | 8 | Yes | None | None | None | 1-6-30 bilateral axillary dissection | None | None | Yes | Died 7-9-31 | No |
| None | 1 | None | None | None | None | 1-6-30 radical | Yes | None | Yes | Died Summer | No |
| None | 7 | None | None | None | None | 10-9 local | Yes | None | Yes | Died 3-19-3 | No |
| None | 1 | None | None | None | None | 4-9-30 radical | Yes | None | None | Died 12-9 | No |
| None | 1 | Yes | None | None | None | None | None | None | Yes | Died 4-15-1 | N |
| None | 4 | None | None | Yes | None | None | None | None | Yes | Died 2-5-26 | No |
| None | 4 | Yes | None | Yes | None | 5-1 radical | None | None | Yes | Died 0-1-32 | No |

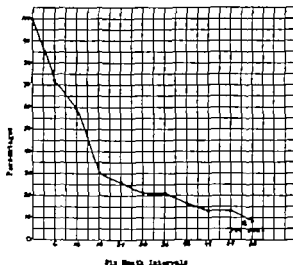


Chart Percentage of survival in patients with disease at six month intervals up to five years

the histology of the tumor should be treated with greater dosages.

Better knowledge more varied and better modalities of treatment together with the knowledge that the skin will stand heavier dosage than was previously supposed and the anatomical position of male breast tumors, offers the radiologist a greater opportunity to cope with this disease. (Table III.)

As a means of relieving the constant pain of bone metastasis and as a method of treating local recurrences, irradiation should be recommended in these otherwise hopeless cases. In instances of radiosensitive tumors (Case 19) it can accomplish definite growth restraint in primary and metastatic areas.

Here also the advanced status of these cases is evident as only 2 patients could be classified as early or primary operable. One patient observed too recently for end result study has been treated by means of gold radon implants, while another patient 83 years of age, was treated by X radiation because of his age and general feeble condition. He died of cerebral hemorrhage 6 months from the time of admission, free from local or metastatic evidence of cancer.

Judd believes that irradiation does not seem to have arrested the progress of the disease to any appreciable extent. Schreiner in his series of cases treated by irradiation

alone had no early cases and all but 1 are dead. This patient was treated for 2 years and 5 months and showed no evidence of recurrence. The 5 other patients are dead, 4 in less than a year and 1 between 2 and 3 years.

END-RESULTS

Twenty-six patients observed prior to January 1928 are considered in Table V. Three patients alive without evidence of disease 5 years or more following mastectomy and postoperative irradiation are tabulated in Table IV.

Two patients now dead lived over 5 years from the date of operation. Case 19 J O N 52 years of age, on admission had noted a tumor mass of the left breast for 2 years. Radical mastectomy was performed September 11, 1920. He died of local recurrence and wide spread metastases August 19, 1927, 6 years and 11 months after operation, and 9 years from the onset of the first symptom.

Case 15 J K 65 years of age, on admission had noted a tumor of the right breast 3 years prior to admission. Radical mastectomy was performed August 13, 1917 followed by post operative irradiation. He died September 16, 1924, 7 years and 1 month following operation, from local recurrences and pulmonary metastases. He lived 8 years from the onset of the first symptom.

These cases emphasize the occasional long survival period in this disease and the necessity for frequent and careful re-examination. If such patients are lost to observation at the end of 5 years, they should not be considered as necessarily cured.

Eighteen patients, or 36 per cent of our total series were classified as primary operable on admission. Ten patients, or 55 per cent, are now alive without disease, only 3 however were treated prior to January 1928. One patient in the primary operable group lived 5 years but subsequently died of recurrence. Another patient first observed in July 1930, is alive with recurrence.

Ten patients, or 21 per cent, were classified as primary inoperable. No patients in this group lived 5 years either with or without disease. All patients are dead except one who now has recurrent disease.

Wainwright gives the details in his table (No 6) of 20 patients dying more than 5 years after operation. In a later end result study (1930) of 41 patients reported alive in April, 1927, Wainwright found 11 had since died—mostly of recurrences—while 4 patients could not be traced. Six of the 11 patients had passed the 5 year postoperative period. Twenty-six are alive at various periods the longest interval being 18 years and 5 months. Of this group of 26 patients 17 are alive more than 5 years after operation. Twenty three, or 56 per cent of 41 cases, lived over 5 years after operation. However, it is not stated how many of these patients were free of disease at this time.

SUMMARY

1 Forty seven cases of cancer of the male breast are reported with an end result study of 6 previously reported cases from the Memorial Hospital.

2 Male breast cancer comprised 1.24 per cent of admissions to the breast clinic and only 0.14 per cent of all cancers in males.

3 The average age of the patients in this group was 54.4 years.

4 The left breast showed a slightly higher percentage of involvement than the right.

5 "Occupational mastitis" due to chronic irritation, is not infrequently a precancerous lesion, however a previously existing benign tumor was noted in only 3 patients, or 6.3 per cent of the series.

6 The incidence of trauma as qualified in the text is recorded as a possible etiological factor in 14 or 29 per cent of the cases. No proved instance of a single trauma causing cancer was noted in this series.

7 The coincidence of gynecomastia with cancer is emphasized and evidence of their relationship is considered on experimental, clinical, and anatomical grounds. Gynecomastia occurred in 9 patients or 19 per cent of this series.

8 The symptomatology pathology, and distribution of metastases corresponds to the well recognized manifestations of mammary cancer in general.

9 The prognosis of cancer of the male breast is poor. Five patients observed prior

to January, 1928, survived 5 years. Three or 11.5 per cent of these 26 patients, are still alive without evidence of disease.

10 Irradiation therapy is to be recommended as a valuable adjunct in the operable group and of great value as a palliative measure in the inoperable cases. Heavier dosage by irradiation methods is recommended.

I wish to thank Dr. Ewing for his review of the microscopical sections, and Dr. Lee for invaluable advice. I am indebted to Drs. Lee, Adair and Treves of the Breast Clinic and Drs. Coley Craver Quick, and Lent for the use of their clinical records.

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PATHOLOGICAL AND CLINICAL DATA CONCERNING POLYCYSTIC KIDNEY¹WILLIAM F. BRAASCH, M.D. F.A.C.S., ROCHESTER, MINNESOTA
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POLYCYSTIC disease of the kidney is discovered often enough on surgical exploration, or at necropsy and occasionally on clinical examination, to warrant review of the pathological and clinical data which may be of aid in its recognition. If the condition is overlooked, it may be the cause of considerable confusion and may even lead to serious consequences. If on the other hand it is recognized, and thorough clinical examination is made a fairly definite prognosis can be given, and the care of the patient may be materially altered.

The data in this article were collected from 193 patients observed at The Mayo Clinic, whose condition had been diagnosed polycystic kidney. Many of the patients returned for subsequent examination, and it was possible to corroborate clinical data previously obtained. Included in this group were 85 patients who were operated on for various renal complications occurring with polycystic disease, or whose renal condition was discovered in the course of operation for other abdominal lesions. Records of necropsy made at the clinic were available in 9 cases and operative specimens were obtained in 10 cases. Thus, histological studies were possible in 19 cases. Moreover the findings at postmortem examination were available, in many of the cases in which death occurred after the patients had returned to their homes.

The incidence of congenital polycystic kidney found at postmortem examination at The Mayo Clinic was 9 in 9,171 cases or a ratio of 1:1,019. The incidence noted clinically was 193 in 680,000 registrations or 1:3,523.

PATHOLOGICAL DATA

The pathological anatomy of polycystic kidneys has been described repeatedly and only a few observations will be noted. As the

cysts increase in size and multiply the pelvis is encroached on and becomes deformed. The calyces may become elongated and broadened, while others are abbreviated or even obliterated. This deformity can be visualized by means of pyelography. Polycystic kidneys are occasionally enormous in our series the largest were those of a man aged 40 years who died of uræmia. Postmortem examination disclosed congenital polycystic kidneys each weighing 7284 grams (approximately 17 pounds). The normal weight of a kidney is 300 grams. The left kidney measured 34 by 20 by 12 centimeters, the right, 33 by 19 by 12 centimeters.

Coincident cystic disease of the liver probably occurs more frequently than clinical data might suggest. In the 9 cases of polycystic renal disease in which postmortem examination was performed associated cystic disease of the liver was found in 4 and of the pancreas in 1. Cystic disease of the liver is usually confined to limited portions of the organ, and is seldom the cause of symptoms suggestive of hepatic disease. Cysts of the liver do not usually attain large size although in 1 case observed the cysts protruded to such an extent from both sides of the liver that they were confused with polycystic renal enlargement. Hepatic cysts are occasionally observed without any accompanying renal involvement. Other organs which have been reported to be involved in cystic degeneration are the ovary, broad ligament, uterus, bladder and epididymis. This associated cystic degeneration would indicate a single origin of the condition, and strengthens the belief that it has a congenital basis.

Polycystic kidney is always bilateral in the adult. Even though on intra-abdominal palpation during the course of operation, one kidney does not seem to be involved, it will

subsequently prove to be cystic. In our series, in only 3 cases did renal enlargement appear to be unilateral at surgical exploration and in 1 of these enlargement of the other kidney developed subsequently. Clinical and surgical reports of unilateral polycystic kidney are of little value unless confirmed by careful postmortem examination.

The relation of polycystic kidney to the condition of the solitary cyst of the kidney is not entirely clear. It would seem probable that the solitary cyst is an acquired rather than a congenital lesion. Occasionally multiple scattered solitary cysts are observed but seldom are they so numerous or of such character as to be confused with polycystic kidney. Solitary cysts are usually unilateral although bilateral occurrence has been reported. Other types of cysts are those frequently found in arteriosclerotic kidneys, and the small, simple cysts that are found in kidneys that otherwise are apparently normal. These cysts are probably the result of localized inflammation or obstruction and occasionally may become very large. Hydatid and dermoid cysts are uncommon; they are easily identified.

Multilocular cysts. Multiple cysts are occasionally confined to one region of a kidney which may resemble in size and appearance the cysts with polycystic disease. The cysts are compactly grouped and are usually situated in one pole of the kidney while the remaining tissue is normal. The condition probably has its origin in tubular obstruction although the possibility of its congenital nature is not excluded. According to our observation this condition is unilateral. It is probable that it has been confused with polycystic disease in those cases in which polycystic kidney has been reported as being unilateral. Six cases of multilocular cysts have been observed at The Mayo Clinic.

Histology. Histological study of polycystic kidneys reveals the cysts to be lined usually with a low flattened type of epithelium; occasionally proliferating areas are seen in which tuft like papillary bunches collect, which often resemble glomeruli. The walls of the cysts are surrounded by a peculiar pale-staining connective tissue, which fills the spaces between the cysts where the renal parenchyma has

been completely destroyed. The content of the cysts is usually an albuminous material containing epithelial cells. Occasionally blood is found. Cholesterol crystal clefts and phagocytic cells containing fat particles are noted often. Depending on the degree of involvement there may be areas of parenchyma, varying from those which appear to be fairly normal to areas in which all parenchyma has been replaced by cystic degeneration. Numerous areas of localized lymphocytic infiltration, with hyalinization of glomeruli are present.

There is usually marked thickening of the smaller arteries and arteriolar walls. This is a very important factor in the progress of the disease, and may be closely associated with hypertension which was present in a large number of our cases (7).

Groups of deeply staining small round cells in a fetal kidney which is the site of congenital polycystic disease have been interpreted as cells of an embryonic nature by Davis and others. In adults with arteriosclerotic changes in the kidney there are cells closely resembling these which are probably lymphocytes.

HEREDITY

The hereditary tendency of polycystic kidney has been noted by many observers, and constitutes one of the chief proofs of its congenital nature. Numerous instances in which several members of a family or members of a preceding and a succeeding generation were afflicted with polycystic disease were noted in our series of cases. In one case the condition was apparently present in representatives of four generations. In 2 cases it had been present in three generations, and in 5 cases in two generations. There is apparently variability in the frequency of inheritance in different families. In view of the pronounced hereditary tendency it would seem logical to consider limitation of progeny. In some cases, sterilization may well be advocated.

AGE AND SEX

Clinical symptoms seldom appear in the first two decades of life and are unusual even in the third decade. If the lesion is not evident in infancy it rarely manifests itself before puberty. Impairment of renal function

or other lesions are not usually evident until the fourth decade. The symptoms have their onset most frequently in the fourth or fifth decade. Eighty-eight patients, 46 per cent of our series, were included in this period of life. A large number of patients has no subjective evidence of disease until the sixth and seventh decades. The oldest patient observed in our series completed a normal span of life, namely, 69 years, before any symptoms appeared.

Several limited series of patients with polycystic disease have been reported in which the incidence was higher among males than among females. This preponderance of males was not borne out in our series of 193 patients, 98 were females, and 95 males.

DURATION OF DISEASE

Of 74 patients reported dead, 22 (approximately 30 per cent) died within 2 years following the onset of the first symptoms. Eleven (15 per cent) died in the period between 2 and 4 years after their first symptoms appeared. In these two groups 45 per cent, approximately half of the patients, lived less than 4 years following onset of their first symptoms. The remaining patients lived from 5 to 20 years, with the exception of 2, one of whom lived 23 years and the other, 36 years. The average age at death in this group was 50 years. Of the 42 patients reported living when last heard from 25 had lived 10 years or more, and 9 had lived 20 years or more. From studies of the renal function, the cardiovascular system, the hemoglobin, and the urine, one may obtain a fair idea of the expectancy of life of the patient.

The length of life will depend largely on the degree to which renal function is maintained and this, in turn, on the degree of pressure exerted by the cysts on the normal renal tissue. There is marked variability in the incidence and size of cysts. When they are so numerous as to preclude much residual functioning renal tissue, and unless they remain very small renal function will gradually diminish. This probably will depend on increase in size of the cysts rather than on the number of cysts. The prognosis for the patient who is in the third or fourth decade of life is uncertain, since evidence of subnormal renal func-

tion usually is not marked until the fifth decade. The patient observed in the fifth or sixth decade, who shows no evidence of diminished renal function, usually will live a life of normal length.

CLINICAL COURSE

The clinical picture presented by patients suffering from polycystic renal disease may vary considerably depending on the stage to which the disease has progressed. The onset of symptoms may be very gradual or extremely sudden. In cases of gradual onset the kidney may go on to almost complete destruction before any untoward symptoms are noted. As the cystic disease progresses, symptoms caused by renal insufficiency will appear such as weakness, periods of malaise, headache and gastric distress. Some patients suddenly give signs of renal insufficiency and uræmia, and may die in relatively short periods of time. Occasionally cerebral hemorrhage occurs in cases in which there is hypertension which had previously caused no distressing symptoms. Complications from intercurrent disease may appear as the result of decreased vitality and lowered values for hemoglobin, and may add materially to the rapidity of the patient's decline. With increased vascular disturbance there may be symptoms caused by hypertension. With cardiac failure, which usually appears late there may be edema and dyspnea.

Patients may be unaware of the gradual, progressive enlargement of the kidneys which may have extended over many years prior to the onset of the first symptoms. Both kidneys may be found greatly enlarged, without apparent serious injury to renal function or to the cardiovascular system. After a varying period however the kidneys become insufficient, the cardiovascular system is impaired and death will follow as a result of uræmia or vascular accident.

SUBJECTIVE CLINICAL DATA

Pain. Pain referred to the lumbar region, or to an upper lateral abdominal region is a common symptom, and is often the reason for seeking medical aid. The pain is usually unilateral, and is described as a dull ache,

although it may become severe. It may be difficult to ascertain its cause, but in some cases in which there is more or less constant pain it is apparently the result of the excessive weight of the greatly enlarged kidney. In others it might be explained by intrarenal or intracystic pressure resulting from increase in size of individual cysts. Occasionally one or more cysts may become of enormous size and be the cause of considerable discomfort. Mechanical pressure on surrounding organs by these cysts may also be a factor. Complete relief has been obtained in several of our cases by surgical evacuation and destruction of large or hemorrhagic cysts. Some patients obtained relief by lying down others by supporting the kidneys with abdominal pads. Sudden hemorrhage into a large cyst may be the cause of severe acute pain. The passage of blood clots, with ureteral obstruction may also be the cause of acute renal pain. Renal pain may be accompanied by fever and other evidence of acute renal infection which may be explained by acute infection of one or more cysts or by ascending pyelonephritis caused by temporary obstruction of a calyx.

Urinary symptoms. Gross hematuria was noted by 66 patients approximately a third of the total number. It usually occurred at irregular intervals was of limited duration and was frequently brought on by violent exercise or jarring. As a rule the hemorrhage was considerable and often accompanied by clot which occasionally caused renal colic. The hematuria is similar to that occurring with renal neoplasm and if but one kidney is enlarged the two conditions may be easily confused. Microscopic evidence of blood was reported to have been found in the urine of 85 patients. Dysuria or frequency of micturition was noted by only 15 per cent of patients.

Miscellaneous symptoms. Nausea and vomiting were noted in 50 cases and were usually due to renal insufficiency. Loss of weight was noted in 115 cases (76 per cent). Weakness usually profound was present in 40 cases. Both loss of weight and weakness are probably the result of and closely associated with, renal insufficiency. The physician should interpret the patient's report of weakness and of loss of weight of recent origin as usually presaging

other evidence of renal insufficiency and as indicative of a serious prognosis.

OBJECTIVE CLINICAL DATA

Abdominal tumor. On physical examination bilateral enlargement was palpable in 151 cases, unilateral enlargement in 30, and no enlargement in 12. Although both kidneys are usually markedly increased in size, there is often a decided difference in volume. It is not unusual to find one kidney but little larger than normal while the other may be several times as large. Failure to determine bilateral renal enlargement on abdominal palpation is a common cause of error in diagnosis, and the lesion is frequently mistaken for renal neoplasm. Other factors, such as fat or muscular abdominal walls, may interfere with clinical recognition of renal enlargement of moderate degree. It is surprising how large the kidney may be and still escape detection in the general physical examination. As the kidneys become enlarged they frequently change their position. They usually assume a lower level and the mistaken diagnosis of simple renal ptosis often is made. Occasionally, lateral displacement of one or both kidneys occurs.

Although the tumor is often cystic, on abdominal palpation particularly if there are several distended cysts on the anterior surface of the kidney it may appear to be firm and solid. In some cases the irregularity of the cysts can be palpated easily. The kidneys move with respiration in many cases while in others they become fixed as the result of perirenal adhesions. If therefore cystic irregularity and soft consistence are not present but instead a unilateral firm, fixed mass is palpated as often occurs, the erroneous diagnosis of renal neoplasm is easily and frequently made.

In several cases varicocele of recent origin occurred on the left side with marked enlargement of the left kidney and would indicate pressure on the large veins on that side. This also might lead to confusion with renal neoplasm because of its frequent occurrence with this condition. Associated congenital deformities were found in several cases.

Blood pressure. Although one of us (Brasch) first called attention to the fre-



Fig. 1. Typical deformity with polycystic kidney characterized by elongation of infundibula and irregular enlargement of minor calyces.



Fig. 2. Similar elongation of infundibula (shown in Figure 1) with crescent-shaped indentations of minor calyces caused by cysts.

quent occurrence of hypertension with polycystic kidney in 1916 it has since been a disputed point among clinicians. Bell and Clauson in 1928 concluded that, 'The available information is strongly against the view that congenital cystic disease of the kidneys is accompanied by persistent hypertension.' This statement is not borne out by our present studies. The blood pressure of 190 patients was noted. Since the average age of our patients was 43 years it would be logical to consider a systolic blood pressure of 145 millimeters of mercury or more as an indication of hypertension; a diastolic pressure of 90 or more was similarly considered. Of our patients 61 per cent had systolic pressures of 145 millimeters or more. In a study of the patients reported dead records showed that 71 per cent had had elevated systolic pressure. In a control group of the same age and sex made up of patients suffering from chronic pyelonephritis 26 per cent had elevated blood pressure and the incidence of hypertension among patients who were less than 50 years of age was 17 per cent. Among the patients

with polycystic kidney who were reported dead 52 per cent of those with hypertension were less than 50 years of age. Similarly, diastolic pressure was found to be more than 90 millimeters of mercury in 55 per cent of the cases and more than 95 millimeters of mercury in 47 per cent. This indicates that the basis for hypertension in polycystic kidney is not directly related to age, but has its origin in vascular disease. This would be corroborated by the work of Hinman and Morrison (1924) and that of Ritter and Baehr (1928) who reported the results of injecting the arterial supply of polycystic kidneys. The latter two workers found a decrease in the size of the small arteries and the arterioles and pointed out the similarity between the clinical course in cases of malignant hypertension and late glomerular nephritis with that of polycystic kidney.

Ocular fundi. There were abnormalities of the ocular fundi in 57 per cent of our cases

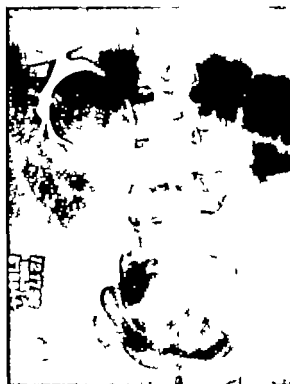


Fig. 3. Semicircular indentation of calyces by cysts, with elongation of calyces and lateral displacement of pelvis.

In 20 per cent there were retinitis and associated retinal sclerosis. In 31 per cent there was retinal sclerosis unassociated with retinitis. In 6 per cent the patients had retinitis only and without changes in the retinal vessels. In 43 per cent examination of the ocular fundi gave negative results. It is evident therefore that the disease involves the entire vascular system.

Hemoglobin and erythrocytes. Brown and Roth have pointed out that there is a definite relationship between the degree of renal insufficiency and the degree of anemia. In their studies, the anemia of chronic nephritis had definite prognostic value approximating that of retention of creatinine. In our group of patients with polycystic kidney the value for hemoglobin of 93 (56 per cent) was 70 per cent (Dare) or less. Erythrocyte counts were less than 4,000,000 in 61 cases (42 per cent).

The urine. The specific gravity of the urine was less than 1.010 in 40.4 per cent of our cases. The value of low fixed specific gravity

from a prognostic standpoint is considerable. Albumin usually in small amounts was found in 180 cases. Urinary casts were observed in 21 cases (11 per cent). Microscopic evidence of hematuria was noted in 85 cases (43 per cent). Pus cells were found in 180 cases (94 per cent) in routine examinations of the urine. Catheterized urine from either kidney often contains a variable number of pus cells. This is apparently the result of inadequate intrapelvic drainage caused by cysts compressing the pelvis or calyces. Ureteral catheterization occasionally will cause acute exacerbation of the infection and should be avoided when possible. Materials injected in the course of retrograde pyelography may be retained in the pelvis and may be the cause of serious renal infection. Organic compounds of iodine which recently have come into use are least irritating but even with these it is advisable to leave the ureteral catheter in place for several hours in order to drain the renal pelvis, and to perform lavage of the pelvis with sterile solutions of boric acid. Although in some specimens obtained by renal catheterization only occasional pus cells were found, this does not exclude previous renal infection and cultures were in some cases positive.

Renal function. Regarding excretion of phenolsulphonophthalein of 40 per cent or less as indicative of renal insufficiency renal function was subnormal in 67 per cent of our cases. In 26 cases return of phenolsulphonophthalein was 31 to 40 per cent in 21, 21 to 31 per cent in 23, 11 to 20 per cent in 18, 1 to 10 per cent in 27, only a trace of the dye, or none of it, was returned. In most cases there was delayed excretion of phenolsulphonophthalein as shown either by a retarded appearance time, or preponderance of excretion of dye in the last hour. Normal excretion of phenolsulphonophthalein should not be regarded as excluding polycystic disease however. In many cases although the specific gravity of the urine was found to be within normal limits (1.014 to 1.020) yet excretion of phenolsulphonophthalein was greatly reduced. Of interest is the lack of parallelism between the excretory and the retention tests for renal function in the earlier stages of renal insufficiency. Excretion of phenolsulphonophthalein

lein is often markedly reduced whereas the value for blood urea is normal or only slightly elevated.

Blood urea The value for blood urea was estimated in 117 cases of this group. In 78 cases (67 per cent) a value of 40 milligrams or more in each 100 cubic centimeters was noted, in 12 cases, it was more than 200 milligrams. In only 33 per cent was the value for blood urea normal. It is remarkable to what extent tolerance to renal insufficiency may be developed with a concentration of blood urea of more than 100 milligrams in each 100 cubic centimeters. A number of cases has been observed, in which the value for blood urea was 150 and 200, and the patients were in a fair degree of health for several years. This is also true when the value for creatinine is between 5 and 10 milligrams for each 100 cubic centimeters of blood.

UROGRAPHIC DIAGNOSIS

The recognition of polycystic kidney is frequently impossible without bilateral pyelography. The deformity of the pelvis as the result of polycystic disease is usually quite typical and easily recognized. It may however be unusual in outline and simulate deformity seen with renal neoplasm so closely that identification is impossible. In such cases a pyelogram of the opposite kidney is necessary. If that pelvis is shown to be normal polycystic kidney can usually be excluded.

The deformity with polycystic kidney seen in the urogram has been described (3) and is characterized largely by marked elongation of the infundibula with crescent shaped or bulbous enlargement of the minor calyces. With this there is frequently deformity and displacement of the renal pelvis laterally and downward. Occasionally there is obliteration of one or more of the calyces by pressure from cysts.

Bilateral simultaneous pyelography in cases of polycystic kidney was a dangerous procedure with the mediums formerly in use. With the employment of the organic compounds of iodine for retrograde pyelography this danger has been largely reduced, but even so one should hesitate to employ bilateral pyelography in the presence of polycystic kidney.



Fig. 4. Abbreviation of calyx by cyst rupture of wall of cyst, connecting it with pelvis.

The advent of intravenous urography has offered an ideal means of diagnosis in many cases. If the outline of the pelvis and calyces is clearly visualized the condition can be recognized without much difficulty. Unfortunately however owing to delay in excretion resulting from renal insufficiency, the details of the pelvis may not be clearly visualized. This is particularly true where the blood urea is more than 60 or 70 milligrams. Nevertheless even in such cases evidence of delayed excretion, fragmentary visualization of elongated calyces, and other data will offer a clue to the diagnosis. In cases of suspected polycystic kidney therefore, intravenous urography should first be employed, and it frequently will obviate the necessity for cystoscopy.

TREATMENT

Knowing the condition present, much can be accomplished by means of general treatment and advice to the patient, who should be informed as to his condition and the usual prognosis. General directions as to the patient's regimen such as dietary precautions consisting largely of restriction of protein, partaking of simple foods and supervision of the amount of exercise hours of rest, and

removal of causes of worry and stress are important factors. Urinary symptoms as a result of secondary infection are best controlled by general antiseptic measures rather than by local treatment.

It has been said that this condition is never surgical. However experience has shown that surgical treatment is often of the greatest value to the patient. Although accidental removal of an uncomplicated polycystic kidney might well be disastrous if the function of the other kidney were insufficient, nevertheless complications may exist which justify surgical treatment. Our experience in this field will be dealt with more fully in a subsequent contribution.

SUMMARY AND CONCLUSIONS

The average age of the patients at the onset of symptoms was 38.8 years. The average duration of life of the patients reported dead was 50 years. There was definite evidence of a hereditary trend. A systolic blood pressure of 145 millimeters of mercury or more was found in 61 per cent of the cases; the diastolic blood pressure was more than 90 millimeters in 55 per cent and more than 95 millimeters in 47 per cent. Peripheral sclerosis was observed in 15.4 per cent. Retinal sclerosis, with other ocular changes, was noted in 51 per cent. Laboratory evidence of renal insufficiency was present in more than 60 per cent of the cases. Surgical complications occurred in approximately 30 per cent, which is a much greater incidence than is usually recorded. There is frequently a lack of parallelism between the retention and excretory tests for renal function; evidence of reduced renal function is usually greater in the latter.

The importance of vascular changes in cases of polycystic kidney has been underestimated in the past. Arteriosclerotic processes may be falsely attributed to developmental disturbances in the tubules and glomeruli. Although a developmental defect probably is primary in the etiology of congenital polycystic kidney, many of the clinical and pathologic manifestations have their origin in an altered condition of the vascular system.

Renal polycystic disease is easily overlooked and usually is overlooked in the

course of general clinical examination since there are often no symptoms present which would indicate renal involvement. The renal origin of the patient's symptoms is often recognized only in the course of routine study of renal function. The condition may be confused with nephritis unless careful abdominal palpation is made. Failure to discover that renal enlargement is bilateral may lead to the erroneous diagnosis of renal neoplasm. Bilateral urographic studies may be necessary to determine involvement of both kidneys when abdominal palpation reveals unilateral enlargement. The most common symptom is a dull pain usually referred to either renal region. Urinary symptoms of moderate frequency and dysuria are often observed. Gross hematuria occurs in approximately 33 per cent of cases and may simulate that occurring with neoplasm. The first clinical symptoms are frequently those of renal insufficiency, although a remarkable degree of tolerance is often noted in the presence of advanced renal destruction. Laboratory evidence of marked reduction in renal function with comparatively few subjective symptoms, in the case of an adult who is in the third or fourth decade of life, should call attention to the possibility of polycystic renal disease. The prognosis will vary largely with the degree of renal dysfunction. If renal function remains normal the prognosis is good. Even moderate reduction of renal function may remain stationary for as many as 10 or 15 years. When the reduction is advanced the prognosis becomes grave, although several years may elapse before death. Expectancy of life will average almost 50 years, although patients are frequently observed who are more than 60 years of age. The hereditary nature of the disease should discourage the having of progeny and sterilization should be considered.

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THE ANATOMY OF THE VEINS OF THE GALL BLADDER

THEIR RELATION TO AN IMPACTED STONE

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IN his textbook of pathology Kaufmann makes the following statement in regard to the effect of obstruction of the cystic duct (usually produced by impaction of a stone) 'Obstruction of the cystic duct usually produces hydrops of the gall bladder. If the obstruction is complete, no fresh bile can flow into the bladder, the bile in the bladder is absorbed by the lymph vessels of the mucosa, and the organ gradually becomes distended with a clear fluid produced by the mucosa. If the obstruction is followed by infection of the gall bladder due to pyogenic organisms from the intestine, empyema of the gall bladder may develop, or a severe and destructive phlegmonous inflammatory process, for occlusion and retention raise the virulence of the bacteria. It is assumed that an empyema after healing can gradually change into a condition of hydrops.' According to this prevailing conception obstruction may lead to infection and infection produces inflammation.

In the study of a long series of extirpated gall bladders, Denton obtained little evidence of infection and the anatomical and histological changes which he observed suggested interference with the circulation of the gall bladder, rather than an inflammatory process. In cases examined within 2 to 3 days after impaction of a stone in the cystic duct he found in the wall of the gall bladder oedema, venous distention, and hæmorrhage or hæmatoma. He attributed these circulatory changes not to an acute inflammatory reac-

tion, but to the pressure of the stone on the veins and lymphatics which drain the gall bladder. He stated that the veins and lymphatics are much more intimately incorporated in the cystic duct than is the cystic artery, and that impaction of a large stone in the cystic duct by direct pressure closes off the veins and lymphatics before the artery and causes varying degrees of circulatory interference.

The lesions produced by impaction of a stone fell into three groups. In 8 mild cases the gall bladder showed only venous distention and oedema. In several specimens analogous but more extensive lesions occurred and there was widespread hæmorrhage. In the most severe cases the gall bladder showed many of the features of hæmorrhagic infarction.

Such a case with a similar interpretation was recently reported by Holden. At operation a stone measuring 3 by 4 by 4.5 centimeters was found tightly wedged in the neck. The gall bladder was extremely distended and filled with blood, the wall showed oedema, hæmorrhage, vascular distention and gangrene of the fundus. These changes suggested that the venous return had been entirely shut off.

Denton holds that infection and inflammation when they do occur are secondary to mechanically produced circulatory changes.

The purpose of this study was to find out whether the anatomy of the veins of the gall bladder favored Denton's viewpoint.



Fig. 2.

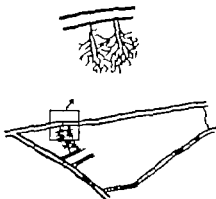


Fig. 5.



Fig. 6.



Fig. 7A.

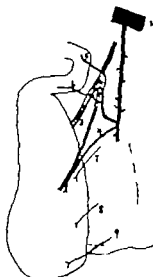


Fig. 7B.

Fig. 2. Normal gall bladder. The gall bladder is covered with a plexus of veins, portions of which are shown in the main sketch of the peritoneal surface and in the side sketch, *a*. From the plexus veins of various sizes lead directly into the liver (see arrows). Another vein leads from the plexus along the superficial branch of the cystic artery (cross-hatched) crosses the bile duct, and joins a small offshoot of the left branch of the portal vein. Slide diagrams *b* and *c* represent cross sections of the gall bladder (*g*) as it lies in the gall bladder fossa of the liver (*L*). They show how the veins enter the liver. Some enter at the margin of the gall-bladder fossa, receiving tribu-

aries from both peritoneal and deep surfaces (*b*). Veins may leave the plexus at this point or at any point deeper in the gall-bladder fossa. When a vein enters the liver at the bottom of the fossa (*c*) the arrangement resembles that of the veins draining the intestine.

Fig. 7A. Normal gall bladder. The photograph of the peritoneal surface was taken under water, after reflection of the serosa and brushing off the surface to remove loose connective tissue. The gall bladder is covered with a plexus of paired veins, between which run the uninjected arteries. Short anastomoses between paired veins are visible. Some of the small veins are unpaired. The smallest ones form a very fine plexus (*Fig. 3*), which, if completely injected, would probably fill the interstices of the coarse network of veins. The large veins, which converge upward and to the left, accompany the ramifications of the superficial branch of the cystic artery. The white spots were produced by rupture of veins and escape of injection fluid.

Fig. 7B. The sketch shows the lateral aspect and undersurface of the gall bladder of Figure 7A, after it had been dissected free from its bed in the gall-bladder fossa (indicated by a broken line) and turned to the left. Only the arteries and veins running to and from the organ are drawn. The cystic artery (cross-hatched) comes down and divides in the usual manner into a superficial and deep branch. The superficial branch on the left runs around the bladder to supply the peritoneal surface; the deep branch is shown on the right, running down to supply the deep surface. The veins are numbered 1 to 10. The right main branch of the portal vein, *p*, is a vein which communicates with *r* and sends branches into the liver all



Fig 5. Cholelithiasis, with a stone measuring 3.0 by 1.0 centimeters lodged in the upper portion of the body of the gall bladder. Distention of the organ below the stone. Injected veins traced in white.



Fig 6. Cholelithiasis, with a stone measuring 2.4 by 1.7 centimeters impacted in the neck, and a much smaller stone in the cystic duct. A small vein running along the duct ends abruptly over the small stone, having apparently been obstructed by the stone.

LITERATURE

The circulation of the gall bladder was studied by Sappey the famous French anatomist. His description of the veins is as follows:

'The veins fall into two groups: those which originate in the superior [peritoneal] surface of the gall bladder and those which

originate in the inferior surface. The former usually give rise to two trunks which either separately or after uniting, empty into the right branch of the portal vein. The latter, twelve to fifteen in number, representing so many small accessory portal veins, leave the

along its course, and, entering the gall bladder fossa, receives 3 and 4 which are the companion veins to the branches of the cystic artery. 3 receives two small veins, 5 and 6 from the cystic duct. Veins 7, 8 and 9 drain the undersurface of the bladder and run upward into the gall-bladder fossa to enter the liver.

Fig. 3. Normal gall bladder. The injection revealed a plexus of paired veins similar to that shown in Figure 2A. The upper sketch shows on a magnified scale the partially injected fine plexus. The blood from this plexus is taken up by forked and paired veins and carried to one of two larger paired veins. The source of the field of the upper sketch is shown in the lower sketch, in which a portion of the plexus of large paired veins is portrayed.

Fig. 4. Normal gall bladder. The sketch shows the peritoneal surface. An artery (cross-hatched) runs along the medial side of the gall bladder in the fissure between gall bladder and liver giving off small branches to the peritoneal and deep surfaces of the gall bladder. Three of

these branches are shown in the sketch. The uppermost crosses the gall bladder and runs on into the liver. The two lower ones sink gradually into the plane of the paired veins concomitantes, which cover the gall bladder just as in Figure 2A. These paired veins are drawn in only at the points of origin of the veins draining the gall bladder. A vein accompanies for a short distance the uppermost branch of the large artery and enters the liver at 1. Veins 2 and 3 unite under the gall bladder to form a vein which runs into the liver at 2, not far from the bottom of the gall-bladder fossa. Another vein enters the liver under the gall bladder at 3, collecting blood from the cranial portion of the deep surface. The large vein 4, which enters the liver with the large artery, receives three tributaries from the peritoneal surface and one from the deep surface. The sketch shows how large unpaired veins arise from the smaller paired veins of the cystic plexus. At their point of origin they leave the plane of the paired veins and become more superficial.



Fig. 7

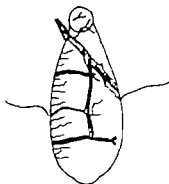


Fig. 8A



Fig. 8B.



Fig. 9A.



Fig. 9B

Fig. 7. Cholelithiasis, with a rounded stone, 1.6 centimeters in diameter firmly impacted in the neck. Below this stone lies loosely another somewhat smaller stone, which can be readily pushed toward the fundus. There is a small herniation of the wall at this fundus. The arrow indicates the point where a large vein enters the liver.

Fig. 8. Cholelithiasis, with a rounded stone, 1.75 centimeters in diameter impacted in the neck. There is a herniation at the tip of the fundus. The usual injection of the cystic duct was followed by an India ink injection of the cystic artery (cross hatched). Figure 8A shows the medial half of the peritoneal surface; Figure 8B, part of the lateral half of the peritoneal surface.

Fig. 9. Cholelithiasis, with a small stone impacted in the first portion of the cystic duct. Hydrops. The photograph (Fig. 9A) of the un.injected specimen shows the peritoneal surface of the gall bladder as seen from the right. The veins are filled with blood resulting in a remarkably complete "natural injection." Nearly all of them lie at right angles to the long axis of the bladder, anastomose freely and run directly into the liver at the margin of the gall bladder fossa. Along the lower margin of the high light runs a large vein (partly hidden) which follows the course of the superficial branch of the cystic artery and terminates at A in Figure 9B. Figure 9B shows the opposite side of the gall bladder.

gall bladder to ramify in the liver lobules which surround the gall bladder fossa.

My own study of the anatomy of the veins both in the normal gall bladder and in gall

bladders with a stone impacted in the neck or cystic duct confirm observations of Sappey in general if not in particular and show that an impacted stone cannot produce venous stasis.



Fig. 10.



Fig. 11A.

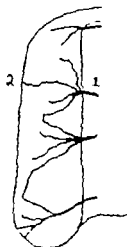


Fig. 11B.



Fig. 12.

Fig. 10. Cholelithiasis, with a stone the size of a cherry impacted in the cystic duct. Gall-bladder wall shrunken and indurated. Veins run in three directions from the stone in the cystic duct. The fundus of the gall bladder is drained by numerous veins, not drawn in the sketch.

Fig. 11. Cholelithiasis without impaction. The wall is thickened in its middle third. Figure 11A shows the medial side of the gall bladder. Figure 11B shows the lateral

aspect of the bladder. The large trunk, marked 1 in Figure 11A, is shown again in Figure 11B. An anastomosis across the top of the bladder is marked 2 in the two figures.

Fig. 12. Cholelithiasis without impaction. A diagrammatic sketch of the peritoneal surface. The two large trunks unite to form a single vein which runs into a large branch of the portal vein.

TECHNIQUE

A method of injecting the veins of the gall bladder was outlined for me by Dr. Blotz of the Anatomical Institute of the University of Hamburg. In order to obtain a complete injection it was necessary to inject not only the gall bladder but also all the surrounding organs. A description of the perfected technique follows.

After opening the body cavity sever the small intestine at the junction of the duodenum and jejunum and remove the jejunum, ileum and colon. Clamp the inferior vena cava close to the right aorta and sever it above the clamp. Remove the heart and lungs. Remove the diaphragm and the remainder of the abdominal organs in one piece. To avoid tearing the liver capsule pull the organs straight forward. Take care not to cut into the liver capsule. Separate the kidneys and the rest of the urogenital organs leaving the suprarenal glands in place. There now remain in one piece the diaphragm, liver, stomach, duodenum, pancreas, spleen, suprarenals, abdominal aorta, and inferior vena cava. Tie off the inferior vena cava above the diaphragm and remove the clamp. Dissect out the portion of the vena cava

below the liver and tie it off close to the liver. Following up one of the large mesenteric veins and the beginning of the portal vein and insert here a cannula plugged with cork (to prevent the entrance of water before the time of injection). Using one or more large curved or straight clamps such as are used in operating rooms clamp off as much as possible of the stomach but especially that portion of the greater curvature affected by postmortem digestion. Place the group of organs in a bucket of hot water at 65 degrees (centigrade) for at least 15 to 30 minutes or until the injection fluid is ready. The water should at the time of injection have a temperature of at least 40 degrees.

Place 250 grams of French gelatin in 1000 cubic centimeters of water for 1 hour then heat over a water bath slowly to about 75 degrees. It is not necessary to filter at this point. After the gelatin has dissolved add 50 grams of cinnabar (vermillion) or 40 grams of zinc white (preferable) and continue the heating and stirring until a homogeneous red or white fluid is obtained. Allow to cool to 65 to 70 degrees. If the liver to be injected is large use 50 per cent more gelatin, water, and coloring matter.

Stretch two layers of gauze over a large glass funnel held in a ring stand. To the funnel attach a long rubber tube of large caliber and clamp the lower end of the tube.

Remove the organs from the hot water and place them on an autopsy table. Pour the injection fluid into the funnel and after it has replaced the air in the tube remove the cork from the cannula and attach the tube. In order to carry out the injection very slowly the funnel is held at the level of the organs at first and then gradually raised until sufficient pressure is obtained but not so much as to burst the veins. The injection should last about one-half hour. The leaks in the preparation are washed off with running water and clamped. As soon as all leaks are stopped the organs are replaced in warm water without interrupting the injection.

After the injection the preparation is placed in ice water in order to hasten the coagulation of the gelatin. When coagulation is complete the cannula and clamps may be removed.

Examination of the liver after the injection shows that the portal vein and its branches contain the gelatin suspension of cinnabar or zinc white while the hepatic vein and its branches contain gelatin mixed with blood the liver capillaries having filtered out the coloring matter. This can be confirmed microscopically by making frozen sections. In the gall bladder the veins contain the injected pigment while the cystic arteries contain gelatin mixed with blood. This interferes with a subsequent injection of the cystic artery and its branches. It also explains the failure of an attempt at simultaneous injection of the arteries and veins by way of the portal vein and coeliac axis.

In order to study the injected veins incise the serosa of the gall bladder down the middle of the free surface and reflect it to either side. In so doing the small veins of the serosa are seen. Next reflect the layer of loose connective tissue in which course the artery and the veins which run to and from the gall bladder (cystic artery and veins). To complete this stage of the dissection it is necessary to lift the gall bladder from its bed. This lays bare the veins of the gall bladder wall (cystic plexus).

Open the gall bladder to inspect the veins of the mucosa (plexus of the mucosa).

A few injections of the cystic arteries, with a needle and syringe filled with India ink or Telchman's mass, were made for me by Professor Grosser of the German University of Prague.

INJECTION OF THE VEINS OF THE NORMAL GALL BLADDER

The results of the injections of the normal gall bladder are shown in Figures 1 to 4. Preparations 2, 3 and 4 (Figures 2A, 3, and 4) show that the gall bladder is covered with a plexus of paired veins which accompany the branches of the cystic artery. This might be called the 'cystic plexus' or 'cystic plexus proper'. Two subsequent preparations showed the same kind of a plexus making a total of five successive injections in which the plexus of paired veins was constant. In Preparation 1 however a plexus of unpaired veins was recorded (Figure 1 and side sketch a). Figure 3 shows a portion of the plexus of very fine unpaired veins which fills the interstices of the coarser plexus.

The cystic plexus is drained by a number of unpaired 'cystic veins' which are very irregular in number, size, and course. Examples of them are shown in Figures 1, 2B and 4 and in all of the subsequent figures (cases of cholelithiasis). They are especially clear in Figures 11A and 11B. Figure 4 shows how these large unpaired cystic veins arise from the smaller paired veins of the cystic plexus. Figure 2B shows how some of the cystic veins (3 and 4) accompany the main branches of the cystic artery while others (7, 8 and 9) do not. Some of the cystic veins could be followed into large branches of the portal vein (Figures 1 and 2B) the others entered the liver and could not be followed by ordinary methods of dissection. They enter the liver at any point in the gall bladder fossa from its margin (Figure 1, side diagram b) to its deepest point (Figure 1, side diagram c).

Not shown in the Figures are the plexus of the gall bladder mucosa and the very small veins of the serosa. The plexus of the mucosa resembles the plexus of the duodenal mucosa which is also injected in these preparations.

It consists of a rich network of small veins, the interstices of which are filled with a network of extremely small veins. Frozen sections of the wall of the injected gall bladder (after embedding in gelatin) show the veins of this plexus and also the veins of the cystic plexus proper, which lie outside the muscularis. The muscularis itself contains small veins, some of which unite the mucosal plexus with the cystic plexus.

The serosal veins in the various preparations take in general a lateral course toward the sides of the gall bladder. Some of them, and especially those in the middle of the peritoneal surface, communicate with the veins of the cystic plexus. The others run off to one side or the other into the liver.

INJECTION OF THE VEINS IN CASES OF CHOLELITHIASIS

The cystic veins were injected in 8 cases of cholelithiasis. In all of the cases the pathological condition of the gall bladder was a collateral finding at postmortem examination, death being due to other causes. In the first six cases there was an impacted stone. In most of these cases the bladder was hydropic and showed signs of a healed process as evidenced by scars in the mucosa, fibrous thickening of the wall with or without shrinkage or adhesions of the peritoneal surface. The results of the injection in the various preparations are shown by photograph, drawing, or diagram (Figs. 5 to 12).

In Preparation 5 (Fig. 5) an unusually large stone was lodged in the upper portion of the body of the gall bladder. In this position the stone could conceivably press on the large veins which accompany the superficial branch of the cystic artery (uninjected) in its course from above on the left diagonally down across the bladder to the right. But from any hypothetical point of pressure the blood would drain off in at least two directions: up and to the left, or down and to the right by the two large veins which run directly into the liver.

In Preparations 6, 7, 8, 9, and 10 (Figures 6, 7, 8, 9 and 10) one or two stones were impacted in the neck or in the cystic duct. In the figures the injected veins are traced in black, while the visible portions of the arteries

are cross-hatched. It was found that the veins in the region of the neck leave the gall bladder below the point where the stone was impacted, and, as the veins in their further course lie in loose connective tissue apart from the neck and cystic duct, they could not be pressed upon by the impacted stone. (In Figure 9B the artery and vein run past the stone impacted in the duct, but not close to it, as the figure would indicate.) Furthermore there are so many veins running from all parts of the body of the gall bladder into the liver that it is impossible for an impacted stone to produce venous stasis.

The following experiment proves that, even if the veins at the neck of the gall bladder are occluded, adequate drainage would occur through the veins which run from the body of the organ directly into the liver.

In a case with a normal gall bladder, the neck of the gall bladder was freed from its attachment to the liver sufficiently to permit a ligature to be placed around it. With the ligature firmly tied the usual injection through the portal vein was made. The injection of the cystic veins was as complete above and below the tie as if no ligature had been placed. From one side of the gall bladder four from the other side three veins, ran directly into the liver. The injection fluid must have entered the gall bladder through these veins, because the veins at the neck were closed by the ligature.

The injury produced by cholecystitis destructiva could conceivably obliterate some of the veins of the gall bladder. Preparation 11 (Figures 11A and 11B) is of interest in this connection, for although the gall bladder was thickened in its middle third, the even distribution of the veins was undisturbed.

The completeness of injection varied in the different cases of cholelithiasis, and was in no case as perfect as that attained in the injections of the normal gall bladder. The "natural injection" of the veins in Figure 9A is of special anatomical interest, because it was unusually complete and because the veins are not exaggerated in size, as in artificial injections. In Preparation 12 (Fig. 12) the course of the veins on the peritoneal surface agrees with the description of Sappey.

OBSTRUCTION OF THE LYMPHATICS

The lymphatics of the gall bladder were not studied. Sappey states that the lymphatics of the gall bladder and the adjacent parts of the liver converge toward and flow into a lymph node located at the neck of the gall bladder. A hypothetical obstruction at this point would in my opinion be relieved by drainage through the lymphatics of the liver, for the lymphatic system as a whole is characterized by an extraordinary richness in anastomoses not only of the smaller but also of the larger vessels (Bartels).

SUMMARY

1. It has been maintained by Denton that impaction of a large stone in the cystic duct by direct pressure closes off the veins and lymphatics which drain the gall bladder and causes circulatory stasis varying from simple distention to hemorrhagic infarction. The anatomy of the veins of the gall bladder was studied to determine whether it supported Denton's viewpoint.

2. Injection of the veins of the normal gall bladder revealed a venous plexus of the mucosa similar to that of the duodenal mucosa, a cystic plexus, which lies just outside the muscularis and usually consists of paired veins concomitantes accompanying the ramifications of the cystic artery and unpaired cystic veins (already described by Sappey as accessory portal veins) which drain the gall bladder. These cystic veins vary greatly in number, size, and course. Some of them accompany the

branches of the cystic artery toward the neck of the gall bladder. Others carry blood around the sides of the gall bladder or from its deep surface directly into the liver by way of the gall-bladder fossa.

3. Injections of the veins in cases of cholelithiasis with impaction showed that the impacted stone cannot by direct pressure cause venous stasis. This is impossible because

a. None of the cystic veins run close enough to the cystic duct to be affected by the pressure of a stone in the duct. Only the veins of the cystic duct itself are affected by such a stone.

b. The cystic artery and its accompanying vein meet (or leave) the gall bladder below the point of impaction of a stone in the neck.

c. Only a very large stone lodged in the upper portion of the body of the gall bladder could press upon large cystic veins. In this case, on account of the rich anastomoses, blood would be carried away in at least two directions from the point of pressure.

d. Only a small fraction of the venous drainage occurs by way of the neck.

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THE RÔLE OF THE EXTERNAL SECRETION OF THE PANCREAS
IN EXPERIMENTAL HIGH INTESTINAL OBSTRUCTIONPAUL N. JOHNSTONE, M.D., ARTHUR C. CLASEN, M.D., AND THOMAS G. ORR, M.D., F.A.C.S.,
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IT has long been known that high intestinal obstruction in dogs is compatible with only a short duration of life. Although there is a minor variation in the longevity of animals with obstructions just below the ligament of Treitz, the results of numerous investigators are substantially the same. According to Haden and Orr (7), who produced obstructions of the upper jejunum in 35 dogs, the average duration of life was 6.8 days. Wangenstein (14) found the length of life of the dog with high intestinal obstruction to be 3 to 4 days, while Dragstedt and Moorhead (1), who obstructed the duodenum below the pancreatic duct, observed that all animals died in less than 96 hours. The earlier studies of Hartwell and Hoguet (9) indicate that few dogs with obstructions 10 to 30 centimeters below the pylorus lived longer than 5 days.

J. W. Draper Maury (12) in 1909, drained the biliary and pancreatic liquids below the site of obstruction. The bile was found to be in no way connected with what he has termed a physiological death. Dogs in which the external secretion of the pancreas was drained into the bowel below the obstruction lived, whereas those in which it was drained above died. To produce drainage below the obstruction the upper pancreatic duct was ligated and the duodenum obstructed between the ampulla of Vater and the major pancreatic duct. Again, Eisberg and Draper in 1918 (4) drained the duodenum and its appendages below the site of upper intestinal obstruction. The entire duodenum with its outbuds, the pancreas and liver, were first separated from the alimentary tract. The pyloric end of the duodenal segment and the stomach were occluded, the duodenum was anastomosed to the jejunum, and posterior gastro-enterostomy was performed. This constituted the primary operation. Two to three weeks later the bowel was obstructed by section and infolding 35

centimeters aboral to the gastro-enterostomy. These animals lived 17 days, in comparison with 6 days in the control animals. They concluded that the duodenum with its appendages was responsible for death in high obstruction. In a later article Eisberg (3) excluded the bile from the obstructed segments, confirming the earlier work of J. W. Draper Maury. According to Sweet, Peet, and Hendrix (13) if the pancreatic ducts are ligated and a high obstruction produced, dogs will live somewhat longer than the average, but life is not strikingly prolonged. This same observation has also been made by Eisberg. This author also concluded that the pancreas is the main source of the toxin in duodenal obstruction. The work of Dragstedt et al. (2) and Mann and Kawamura has shown that the entire duodenum may be surgically removed in animals without causing death if the bile and pancreatic secretions are preserved by transplanting the ducts of the gall bladder and pancreas.

In our review of the literature we find much experimental evidence pointing to the importance of the external pancreatic secretion as a lethal factor in intestinal obstruction. In order to gain further information in regard to this important secretion and its relation to intestinal obstruction, we have made a study in which the major portion of the external secretion of the pancreas is preserved by draining it into the jejunum below the point of the high obstruction. This is accomplished by transplanting a small section of the duodenum, containing the ductus Santorini, into the jejunum below the point of contemplated obstruction. Thus the adjacent organs, namely the stomach, liver, and the duodenum remain physiologically intact while the pancreas is drained into the unobstructed intestine. We have thus isolated only one organ, the pancreas, so that the preservation of the major portion of its

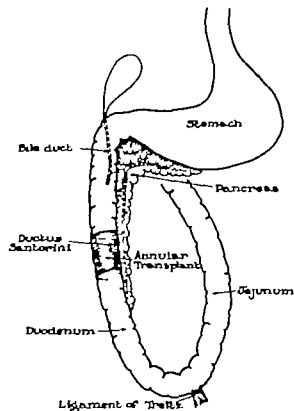


Fig. 1. Diagram showing section of duodenum with major pancreatic duct to be transplanted.

external secretion can be properly evaluated. These animals have received absolutely no treatment. Following the operations under ether anesthesia they have been returned to metabolism cages and have been offered water *ad libitum*.

In dogs there are two pancreatic ducts. The upper or duct of Wirsung enters the duodenum at the ampulla of Vater with the gall duct. This duct is quite small and relatively of much less importance than the duct of Santorini. The latter duct conducts the major part of the secretion of the pancreas into the alimentary canal.

TECHNIQUE

In all 6 animals are reported. The experiment was done in two stages. The first stage consisted in the transplantation of a section of the duodenum, approximately 3 centimeters in length containing the duct of San-

TABLE I.—BLOOD CHEMICAL STUDIES

After Obstruction of Jejunum Below Ligament of Treitz With Previously Transplanted Pancreatic Duct (D. Santorini) Distal to Obstruction

| Dog No. | Day after operation (obstruction) | Blood | | | | CO ₂ combining power (vol. per cent) | Weight in lbs. |
|---------|-----------------------------------|---------------------------|----------------------------|-----------|-------|---|----------------|
| | | Milligrams per 100 c. cm. | | | | | |
| | | Urea nitrogen | Total non-protein nitrogen | Chlorides | Sugar | | |
| 1 | | 8 | 32 | 300 | 82.8 | 40.4 | 6.25 |
| | 1 | 14 | 33.8 | 295 | 69.9 | 41 | |
| | 2 | 20.4 | 33.8 | 370 | 51 | 44 | 17 |
| | 9 | 20.6 | 71.4 | 240 | 91 | 46.7 | |
| | 14 | 14 | 35.8 | 323 | 101.6 | 53.4 | 18 |
| | 15 | 23 | 37.5 | 325 | 132.6 | 73.8 | |
| 2 | 18 | 18.5 | 61.8 | 263 | 134 | 55.8 | 4 |
| | 20 | Death | | | | | |
| | 21 | 7.7 | 51.8 | 338 | 47 | 47.4 | 13.6 |
| | 27 | 10.7 | 30.7 | 305 | 7.9 | 46.9 | 13.3 |
| | 3 | 7 | 43 | 413 | 86.9 | 46 | |
| | 6 | 9.7 | 47.2 | 315 | 117.4 | 8.8 | |
| 3 | 10 | 8.8 | 36.6 | 3.5 | 74.6 | 81.8 | 11.8 |
| | 26 | 4 | 40.6 | 306 | 96 | 66.3 | |
| | 29 | 1.3 | 46.9 | 290 | 107.6 | 81.7 | |
| | 30 | 16 | 71.2 | 300 | 74.6 | 97.3 | 9.3 |
| | 31 | Death | | | | | |
| | 1 | 1.3 | 31.4 | 466 | 64.6 | 44.3 | 3.7 |
| 4 | 6 | 8.4 | 33.8 | 230 | 61.4 | 51.6 | |
| | 20 | 21.9 | 36.7 | 365 | 79 | 47.3 | |
| | 26 | 1.4 | 38.9 | 306 | 74 | 36.5 | |
| | 30 | 36 | 45 | 285 | 86.3 | 36 | |
| | 1 | 28.7 | 12.3 | 375 | 96 | 39 | |
| | 12 | 20.7 | 66 | 326 | 91 | 36 | 1.9 |
| 5 | 19 | Death | | | | | |
| | 20 | 9.8 | 23.7 | 470 | 64.6 | 46.4 | |
| | 21 | 7 | 4 | 410 | 66 | 37.2 | 7 |
| | 1 | 7.9 | 30 | 340 | 13.6 | 36.9 | |
| | 9 | 29 | 18.7 | 370 | 79 | 79.6 | |
| | 16 | 6 | 20.4 | 370 | 61.7 | 27.6 | |
| 6 | 23 | 14 | 26.9 | 306 | 66.3 | 27.3 | |
| | 25 | 16.8 | 3.8 | 230 | 7 | 74.9 | |
| | 26 | 0 | 32.6 | 306 | 62.3 | 73.4 | |
| | 28 | 20.8 | 35 | 353 | 97.3 | 8.9 | |
| | 29 | 14.6 | 30.8 | 266 | 79 | 94.3 | |
| | 30 | 20.6 | 41 | 230 | 96 | 37.3 | |
| 7 | 31 | 1.9 | 66.7 | 130 | 96 | 96 | 7.5 |
| | 1 | 3.8 | 27.3 | 450 | 61.3 | 41.6 | 7.4 |
| | 7 | 4 | 5.7 | 490 | 73.3 | 36.3 | |
| | 10 | 14.9 | 29.4 | 440 | 36 | 66.7 | |
| | 11 | 3 | 33.9 | 440 | 91.6 | 62.5 | |
| | 1 | 3 | 36.5 | 494 | 79 | 73.7 | |
| 8 | 7 | 4 | 34.9 | 370 | 81.3 | 74.9 | |
| | 12 | 46.3 | 85.3 | 370 | 23.4 | 66.4 | 2.9 |
| | 18 | Death | | | | | |
| | 19 | 20.8 | 20.8 | 490 | 66 | 42.6 | 7.7 |
| | 1 | 17.7 | 29.4 | 470 | 68.3 | 34 | |
| | 12 | 19.9 | 3 | 460 | 66.7 | 51 | 7.4 |
| 9 | 17 | 18.3 | 25.7 | 360 | 96 | 71.8 | |
| | 27 | 27.3 | 43 | 260 | 137 | 83.4 | |
| | 29 | 20.9 | 43.6 | 330 | 134 | 71.6 | |
| | 30 | 79.0 | 121.5 | 130 | 134 | 166 | 4.4 |
| | 31 | Death | | | | | |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

torini into the jejunum 20 to 25 centimeters below the ligament of Treitz. This was accomplished by a double end-to-end anastomosis (Figs. 1 and 2). The continuity of the duodenum was established by an end-to-end union.

Following the above operation the animals were allowed to recover completely from the operation and regain any lost weight. The jejunum was then obstructed just below the ligament of Treitz above the transplanted pancreatic duct.

OBSERVATIONS

Chemical studies of the blood have been made at repeated intervals of each of the animals. The results are similar to those found in simple high obstruction of the jejunum (7), although the changes are slower in developing (Table I). A careful autopsy has been done on each dog and all animals excluded in which a patent ductus Santorini could not be demonstrated.

The recovery of the dogs was rapid after the second operation. They vomited infrequently and the loss of weight was quite gradual. Their period of survival was from 18 to 31 days with an average of $23\frac{1}{2}$ days.

At autopsy the animals showed a striking degree of emaciation. The panniculus adiposus had practically disappeared and the omentum was reduced to spiderweb consistency. There was practically no body fat to be found and the tissues possessed a waxy appearance. The intestine below the obstruction was thin and collapsed. Above the obstruction, the gut was uniformly enormously distended with liquid. There was always considerable liquid in the stomach. Both pancreatic and bile ducts were demonstrated as patent by the passage of a probe.

SUMMARY

When the major part of the external secretion of the pancreas was preserved by drainage into the intestine below the site of an obstructed jejunum the survival period of dogs in our series was 300 to 400 per cent longer than when the secretion was not preserved. The average duration of life of 6 dogs was $23\frac{1}{2}$ days. These results closely parallel the published work of Elsberg and Draper (4) and of Jenkins (10) in which the secretions of the liver, duodenum and pancreas are drained into the jejunum below the site of the obstruction. It is well established that if the first loop of the jejunum be divided and its proximal end

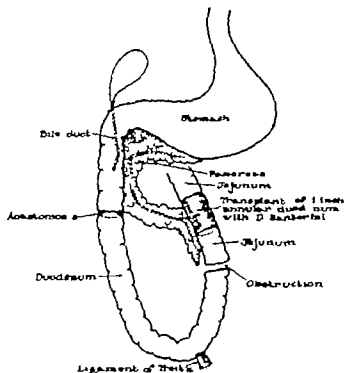


Fig. 3. Diagram showing transplanted section of duodenum with major pancreatic duct. The site of anastomosis and jejunal obstruction are also indicated.

drained to the outside, so that the upper intestinal secretions are lost dogs die as quickly as if the jejunum had been simply obstructed (8).

It is now recognized that the pancreatic fluid is essential to life. Elman and McCaughan (5) and Hartmann (6) have demonstrated that the total loss of the external secretion of the pancreas in dogs results in death within 6 to 8 days. This is a comparable length of time to their survival period when the first loop of the jejunum is obstructed or completely drained.

CONCLUSIONS

1. A series of 6 dogs are here reported in which the major pancreatic duct has been transplanted into the jejunum and the pancreatic secretion preserved below a high jejunal obstruction. Such animals have lived an average of $23\frac{1}{2}$ days.

2. Dogs with high jejunal obstruction in which the external secretion of the pancreas was preserved lived approximately three times as long as dogs having simple obstruction in the same location.

3 It seems quite evident from these experiments and those of others, that the early death from high intestinal obstruction is intimately associated with a loss of the pancreatic juice.

4. We do not attempt to explain what element or elements of the pancreatic juice, when preserved tends to prolong life in acute high intestinal obstruction

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INTRA-ABDOMINAL PRESSURES CREATED BY VOLUNTARY MUSCULAR EFFORT

I TECHNIQUE OF MEASUREMENT BY VAGINAL BALLOON

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MEASUREMENT of the maximum intra-abdominal pressure which can be created by voluntary muscular effort is of interest to the obstetrician and gynecologist in view of the rôle which it may play in relation to labor and to the etiology of prolapse.

Measurements can be made indirectly by recording pressure transmitted to an air inflated balloon within the vagina. The present report describes such a technique, discusses the relation between the vaginal and the intra-abdominal pressures, and records some measurements made by this method.

LITERATURE

Since the observations of Weber (1851), who first observed that extreme expiratory effort may diminish or obliterate the peripheral pulse, about 100 reports have been published which deal with intra-abdominal pressure in man. In general, these studies have followed three lines: (a) the relation of abdominal to atmospheric pressure; (b) the levels of pressure in different parts of the abdomen when at rest; and (c) the influence of respiration upon the pressure.

Experimental data are presented in about 50 of these reports of which 27 (Table I) record the pressure in man. Only three record pressures created by voluntary muscular effort.

MATERIALS AND METHODS

The technique outlined in the present study was developed upon 29 applicants to the Gynecologic Out Patient Department of the Hospital of the University of Pennsylvania, and the measurements in Table II made on healthy volunteers.

Apparatus. The apparatus (Fig. 1) consisted essentially of a rubber balloon which was an ordinary commercial condom connected to a simple U tube mercury manom-

eter. The balloon was fastened by elastic bands to a perforated rubber stopper, which possessed a groove near one end and was fitted over a piece of brass tubing 9.0 centimeters long, with an outside diameter of 0.8 centimeter. An oval metal shield, 9.0 centimeters by 5.0 centimeters, was attached at right angles to the tube, 6.0 centimeters from its vaginal end. The apparatus was immobilized in the vagina by straps (2 anterior and 2 posterior) extending from the shield to a belt at the waist. The balloon was immobilized by a rubber cup fitted to the tube just below the rubber stopper. This prevented it from being forced down around its point of attachment and out of the vagina when the patient strained.

The cup (Fig. 2) was made of fine quality soft rubber. Its base was 2.5 centimeters in diameter, and 0.8 centimeter in thickness. Its sides were 5.5 centimeters high and 0.2 centimeter thick at the base, tapering to paper thinness at the rim, which was 8.0 centimeters in diameter. Insertion of the balloon and cup into the vaginas of deflorated patients was easy and the apparatus caused no discomfort while in position.

Technique of measurement. The bladder was emptied prior to each series of tests. The cup and balloon were placed in the vagina, the shield being placed firmly against the vulva, after which the straps were fastened to the belt at the waist. The balloon was inflated with air in order to fill the vagina, and the pressure within the system was regulated by movement of water in a pair of gravity bottles.

The patient was given preliminary instructions to strain slowly with maximum effort for each test. The tests were made at intervals of not less than 2 minutes, which we thought was sufficient time to afford an adequate rest period.

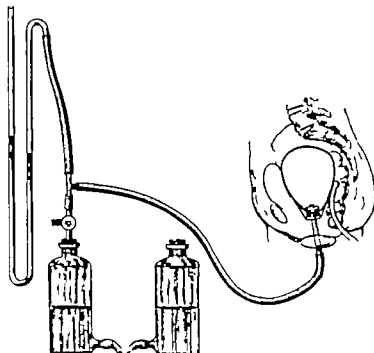


Fig. 1. Diagram of apparatus. Note balloon in vagina. In practice, the system contained air though in order to obtain the lateral roentgenogram from which this illustration of the pelvis was made, the vaginal balloon was filled with a roentgen opaque fluid. The balloon and vaginal apparatus are connected with a mercury manometer; the pressure within the system is regulated by movement of water in the gravity bottles.

The pressure recorded in the vagina when the patient strained was influenced by a number of circumstances

1 Sudden sharp muscular contraction set the mercury column into simple rhythmic vibration. Under such conditions, the column of mercury reached a much higher level on the

first up swing than when the muscular contraction was slow. However if the patient was instructed to strain slowly and to maintain her maximum effort for an appreciable time, this difficulty was eliminated. These observations were confirmed by kymographic records of each type of muscular effort. They demonstrated clearly that sudden sharp contractions gave erroneous results, but that slow steady effort gave true readings.

2 The efforts of a patient on the first test day were usually weaker than subsequent ones due to the newness of the experience and lack of habit formation.

3 The ability of the patient to equal her highest record on a given day when under otherwise identical experimental conditions, was lowered by worries not connected with the test.

4. It was found essential to indicate the moment for each effort by a command, constant in word and tone. Deviation from this



Fig. 2. Detailed diagram of vaginal apparatus. Hollow metal tube with metal vulvar shield supports a partially inflated rubber balloon attached to rubber stopper which is connected to floor of a rubber cup.

TABLE I.—INTRA ABDOMINAL PRESSURE
IN MAN

Chronological table of reports in the literature which deal with the measurement of intra-abdominal pressure, and in which man was used as test object. Note (1) that only 3 authors (Braune, 1865; Dubois, 1876; Hoermann, 1905) measured pressure on voluntary muscular effort, (2) that only two observers (Mithras, 1906; Bohnen, 1931) employed a balloon in the vagina (3) that neither of the latter measured pressures created by voluntary muscular effort.

| Date | Author | Method | Number of subjects | Voluntary effort |
|--------------------|----------------------------------|--|---------------------------|-------------------|
| 1865 | Braune, W. | Tube in rectum | | Measured |
| 1876 | Schätz, F. | Balloon in uterus during labor. Tube in stomach. Cannula in abdomen of cadavers | | N.M. [†] |
| 1874 | Knemling Lars, H. | Tube and balloon in esophagus and stomach | | N.M. |
| 1875 | Odebrecht, E. | Catheter in bladder. Tube in rectum | | N.M. |
| 1876 | Wesdt, E. | Tube in rectum | (self) | N.M. |
| 1876 | Dubois, P. | Balloon in bladder and rectum. Cannula in abdomen of patient with ascites | 30 | Measured |
| 1878 | Quincke, H. | Cannula in abdomen of patients with ascites | | N.M. |
| 1883 | Moss, A. and Pellicani, P. | Catheter in bladder | 3 | N.M. |
| 1883 | Kronacker and Melitz- er | Tube in esophagus | | N.M. |
| 1883 | Schreiber, J. | Tube in esophagus | 6 | N.M. |
| 1884 and 885 | Ahlfeld [‡] | Balloon in rectum of children | | N.M. |
| 1888 | Welmker, Cl. | Tube in rectum and stomach | (self) | N.M. |
| 1893 | Hogge, A. | Tube in fistula of pelvic cyst. Catheter in bladder. Cannula in abdomen of patients with ascites | 4 | N.M. |
| 1893 | Kellmg, O. | Tube in stomach | 6 | N.M. |
| 1895 | Moritz | Balloon in stomach | 3 (self and others) | N.M. |
| 1896 | Kellmg, G. | Tube in stomach | 60 | N.M. |
| 1905 | Hoermann, K. | Catheter in bladder. Tube in rectum | 13 | Measured |
| 1906 | Mithras, P. | Balloon in vagina | 3 | N.M. |
| 1909 | Wetiz, W. | Cannula in abdomen of patients with ascites | 23 | N.M. |
| 1911 | Eagles | Ball jar with rubber diaphragm on abdomen | | N.M. |
| 1911 | Kaiser K. F. L. | Balloon in rectum | 15 | N.M. |

TABLE I.—INTRA ABDOMINAL PRESSURE
IN MAN—Continued

| Date | Author | Method | Number of subjects | Voluntary effort |
|---------------------|------------------|--|--------------------|------------------|
| 1911 | Idem. | Balloon in rectum | 0 | N.M. |
| 1920 | Palper, A. | Balloon in rectum of children | | N.M. |
| 1921 | Kepplich, J. | Cannula in peritoneal cavity of patients about to undergo laparotomy | 51 | N.M. |
| 1923 and 1924 | Widlegans, H. | Cannula in peritoneal cavity of patients about to undergo laparotomy | 60 [§] | N.M. |
| 1926 | Wagnow G. W. | Cannula in abdomen of cadavers | 30 | N.M. |
| 1931 | Bohnen, P. | Balloon in vagina. Pneumograph on chest and abdomen | 90 | N.M. |

*Number of subjects not determined from article.

†N.M., Not Measured.

‡Quoted by Emerson (4).

§Quoted by Eagles (7).

¶Readings given in only 4 cases.

procedure resulted in significant differences in the pressures which were created.

5 The level of the reading was also affected by posture. The influence of this factor is treated in detail in the second paper of this series.

6 A full bladder or rectum obviously limited maximum effort.

RELATION OF ABDOMINAL AND VAGINAL PRESSURES

The initial inflation of the balloon was based upon the amount of air which was required to fill the vagina, as indicated by the patient's first sensation of distention. In order to secure a satisfactory figure which would represent this pressure level, a group of 29 individuals was given an average of 4.9 tests apiece. In order to eliminate the hydrostatic weight of the viscera, the vagina was inflated slowly with the patient in a 30 degree Trendelenburg posture. The limits of pressure sufficient to create the first sensation of distention varied from 1.0 centimeter to 8.7 centimeters the average being 3.6 centimeters. Actual pain was experienced by different subjects at levels which varied from 7.5 centimeters to 10.0 centimeters. On the basis of these observations 4.0 centimeters was selected as a suitable pressure for filling the vagina.

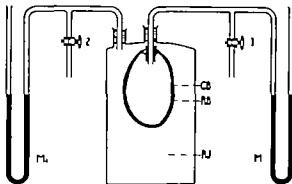


Fig. 3. Diagram of apparatus devised for testing relation between pressure created in abdomen on voluntary muscular effort, and pressure recorded in vaginal balloon. *RB* rubber balloon, *CB* cloth bag (simulating vagina), *RJ* reservoir jar (simulating abdominal cavity) *M₁* and *M₂* mercury manometers attached to balloon and reservoir jar respectively 1 and 2 stopcocks.

The influence of the initial inflation pressure upon the final reading was tested on the volunteers. Three individuals each in a different posture were subjected to 25 tests apiece with basic inflation pressures of 2.0, 4.0 and 6.0 centimeters of mercury (Table II). The two greatest differences in this table (patients *M. F.* and *A. W.* at pressures of 4.0 and 6.0 centimeters) were selected for computation of standard errors. In each case, the actual difference between the averages fell well within the limits of 3 standard errors. Consequently it seems that the differences among the averages resulting from tests made with these initial inflation pressures are not significant and that such basic pressures may be disregarded in estimating intra abdominal pressure by the vaginal balloon technique.

The relation of the pressure recorded in the vagina to true intra-abdominal pressure was also studied experimentally by means of the apparatus shown in Figure 3. This consisted of one air system within another each connected with its own manometer. The outer system, representing the abdomen was a glass jar *RJ* approximately 25 centimeters high and 20 centimeters in diameter with a capacity of 7,860 cubic centimeters. The inner system representing the vagina and its balloon, consisted of a cloth bag *CB* and a rubber balloon *RB*.

Basic vaginal inflation could be simulated by introducing air into the inner (balloon)

TABLE II.—INFLUENCE OF INITIAL VAGINAL INFLATION PRESSURE UPON THE AVERAGE PRESSURE OF A SERIES OF VOLUNTARY STRAINING EFFORTS

Each of the 9 averages was computed from 25 tests. Note the absence of any significant effect.

| Initial inflation pressure cm. Hg. | Average pressure on effort cm. Hg. | | | |
|---------------------------------------|---------------------------------------|--------|-----------|---------|
| | Patient | M.F. | A.K. | A.W. |
| | Posture | Supine | Recumbent | Sitting |
| | | 19.0 | 11.2 | 1 |
| 4 | | 20.6 | 2.3 | 14.8 |
| 6 | | 7 | 11.3 | 17 |

system and intra abdominal pressures created by voluntary muscular effort by introducing air into the outer (jar) system.

The balloon system was inflated until manometer *M₂* recorded a pressure of 1.0 centimeter and this level maintained by closing stopcock 2. The pressure in the reservoir jar was then raised slowly (manometer *M₁*). Pressures in the two systems were recorded with each centimeter increment in jar pressures between 10 and 200 centimeters without altering the original inflation pressure of 1.0 centimeter in the balloon. The experiment was repeated by means of basic balloon inflation pressures of 2.0, 3.0, 4.0, 5.0, 6.0, and 7.0 centimeters of mercury. The results are plotted in Figure 4.

The dot dash line indicates theoretical coincidence of balloon and jar pressures. The continuous line paralleling the greater part of the dot dash line represents the actual relationship between the pressures in the jar and the balloon. The parallelism and the distance between the continuous and the dot dash lines, indicate the close relationship between the actual and theoretical pressures. The distance between the 2 lines represents a difference of 0.7 centimeter between theoretical and actual pressures, i.e. the balloon pressure is 0.7 centimeter higher than the jar pressure. This increase was due to the elasticity of the balloon as indicated by the following experiment.

A rubber balloon of the type used, was connected directly to a mercury manometer and inflated until it was about 10.0 centimeters in

diameter From the onset of the distention, the manometer registered approximately 0.7 centimeter

It will be noted that the solid line representing actual balloon jar relationships becomes straight only after pressure in the jar overcomes the basic pressure in the balloon. The higher the balloon pressure, the higher the jar pressure had to be raised before the various curves representing basic balloon pressures of 10, 20, 30, 40, etc., centimeters joined the straight solid line. For example, with a basic balloon setting of 40 centimeters all jar pressures greater than 8.5 centimeters may be read directly from manometer M_1 less the constant difference of 0.7 centimeter. In general, the balloon pressure records the jar pressure less 0.7 centimeter when the latter is a little more than twice the former. The application of this general law has previously been shown in Table II and can be tested in any subject by demonstrating that initial balloon pressures varying between 20 and 60 centimeters of mercury cause no significant change in the measured abdominal pressure.

Since in our tests of human subjects, the basic inflation pressure of the vaginal balloon was usually 4.0 centimeters, and because most of the subjects raised the mercury level above 8.5 centimeters, we conclude from the experiments on the human and the phantom that the pressures recorded in the vagina represented true intra abdominal pressures when the latter were greater than 8.5 centimeters of mercury.

RESULTS

A Vaginal size In order to gain an idea of the size of the distended vagina, anteroposterior and lateral roentgenograms were taken of 3 of the test subjects. For the anteroposterior roentgenograms, the vaginal balloon was distended with air and exposures were made using 3 levels of inflation. Figure 5 is an artist's drawing of the pelvis of R. M. (who had the smallest vagina of the subjects) when the vaginal balloon was under pressures of 2.0, 3.5, and 7.9 centimeters of mercury. It was obtained by tracing the outline of the pelvis and the balloon from three anteroposterior roentgenograms and shows the large size of the vagina in relation to the pelvis. None of

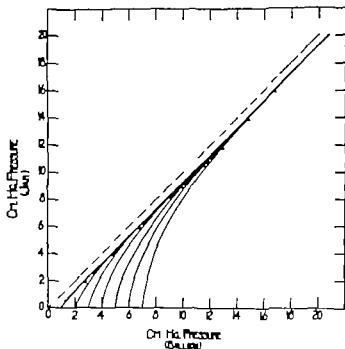


Fig. 4. Curve showing the relation between pressures (expressed in centimeters of mercury) in reservoir jar and bag shown in Figure 3. The abscissas record pressures in the cloth enclosed rubber balloon; the ordinates, pressures in reservoir jar; the dot dash line represents theoretical relation between the two pressures. The continuous line represents the actual relation and records a constant difference of 0.7 centimeter of mercury in favor of the bag system due to elasticity of the rubber balloon. The arrows indicate the points at which the balloon pressures coincide with the jar pressures. Note (1) that the pressures in the balloon coincide with the pressures in the reservoir jar after the initial inflation pressures of the balloon are overcome, and (2) that these points are reached when reservoir jar pressures are slightly more than twice the initial inflation pressures of the balloon.

the three pressures required to produce the pictured distention caused the subject any pain

For a lateral view it was necessary to fill the vaginal balloon with a liquid contrast medium. Figure 6 is an artist's interpretation of a lateral roentgenogram of patient A. K. The vaginal balloon and the bladder were each filled with an X ray opaque liquid and the rectum was distended with air. This illustration is also an accurate representation of anatomical relations and is based on a tracing from the roentgenogram. The inflated balloon is seen to extend out of the true pelvis, for its upper part rises slightly above a line drawn from the top of the symphysis to the promontory of the sacrum.

B Measurements A total of 1,167 tests on 5 healthy subjects was made to determine the



Fig. 5. Composite tracing of three anteroposterior roentgenograms of pelvis of subject R. M. when the vaginal balloon was under pressures of 2.0, 3.5, and 7.9 centimeters of mercury.

Influence of posture upon intra-abdominal pressures created by muscular effort. Detailed analyses of these data are reported in the second paper of this series. The average height to which the mercury column was raised by these 5 women irrespective of posture and with the arms hanging free at the sides was 13.7 centimeters of mercury—a pressure of 2.65 pounds per square inch or 186.2 grams per square centimeter.

C. Reliability. The 1167 readings represented 35 series of tests on 5 subjects, each tested in 7 postures. The average number of readings in a test series was 33, the lowest and highest numbers being 15 and 130 respectively. The ranges of the different test series varied greatly. The lowest was 2.4 centimeters of mercury and the highest 14.3, while the average range of the 35 test series was 6.8 centimeters of mercury.

Standard errors of ± 1 of the 35 averages were calculated including the series whose ranges were smallest and largest. The standard error of the average of the test series having the smallest range was ± 0.15 centimeter while three series having approximately average ranges had standard errors of ± 0.35 , ± 0.36 , and ± 0.36 centimeter of mercury. Even in the test series with the greatest range and the average of which (18.1 centimeters) had the largest standard error there was a variability of only ± 0.71 centimeter. In other words the true average of this test series

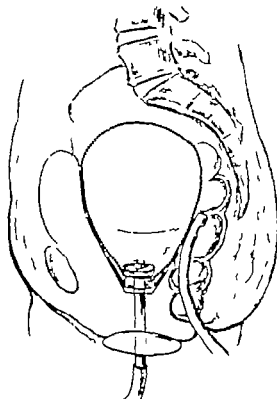


Fig. 6. Artist's interpretation of tracing of lateral roentgenogram of subject A. K. Vaginal balloon and bladder distended with X-ray opaque fluid. Rectum filled with air. Bladder outlined by dotted line, balloon by interrupted crosses. Rectum indicated by rectal tube. Note that the superior surface of the balloon rises above an imaginary line drawn from top of symphysis to promontory of sacrum.

probably lay between 17.39 centimeters and 18.81 centimeters of mercury.

The number of tests required to give an average within ± 0.5 centimeter of mercury varies with the patient. Some of our subjects were so constant in their ability to create pressures within a few centimeters of a central point that a series of as few as 15 tests sufficed. In general about 25 separate tests were needed in order to give a satisfactory average, while with one patient who did not co-operate well about 40 tests were necessary.

CONCLUSION

From our observations, it is concluded that the vaginal balloon technique is satisfactory for measuring intra-abdominal pressures created by voluntary muscular effort.

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CLINICAL SURGERY

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A NEW METHOD OF REPAIRING KIDNEY WOUNDS²

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IT has long been known that extensive destruction to the kidney has followed nephrotomy. Most of this renal impairment can be attributed to the placing of sutures through the kidney tissue to obtain approximation of the edges of the incision and at the same time to control hemorrhage. Sutures thus placed must necessarily compress the vessels supplying the cortical and medullary substances of the kidney and thereby produce an ischemia with resultant necrosis and scarification.

The present paper is a preliminary report of an experimental and clinical study of the repair of kidney wounds by a new method of closure. The method was first suggested by Mr. William P. Didusch of Baltimore and New York. In a private interview and the authors wish to give him credit for the original idea. Rabbits were the first animals used in the operations and they served the purpose well in demonstrating that the procedure was practical. The rabbit's kidney is rather small and it was deemed advisable to use larger animals in the subsequent investigations. Dogs were substituted in the second series of experiments and they have proved to be entirely satisfactory.

Before attempting the procedure upon a living human subject it was carried out upon the kidneys of a cadaver and proved to be practical. Thus fortified, the first operation upon a human being was performed before a clinic of the Genito-Urinary Section of the New York Academy of Medicine on February 15, 1933. Subsequently 4 additional cases have been operated upon. The 3 earlier cases are now completely convalescent and complete protocols are included in the text of this report. The 3 latter are too recent to be included here but as this goes to press all are in entirely satisfactory condition.

The authors have modified the method in slight details as their experience has progressed, but the original principle has remained unchanged, namely: closing the kidney by tying broad ribbon gut around the injured part of the kidney just as

one would wrap a parcel with ribbon. No effort will be made herein to report the functional efficiency following this type of kidney closure. These studies are now in progress and will be reported in a subsequent paper as well as investigations of the anatomical repair of the wounds.

LITERATURE

True nephrotomy was practiced for the first time in 1880 by Morris of England, who removed a stone from a non-suppurating kidney. The patient survived and many surgeons in England, America, and Germany followed Morris' example. Among these pioneers were Le Dentu and Brodeur in France; Morris, Bruce Clark, Newmans, and Dickinson in England; Kelley and Cullen, of America; Israel and Kuemmel, in Germany. Each added to the methods employed. The researches of Tuffier and the anatomical studies of Broedel, Zondek, Albarran, Pappa, Delbet, and Macquot led to modifications of the classical nephrotomy incision.

The various methods of repairing nephrotomy wounds have been studied and will be briefly mentioned. Morris did not use any sutures but merely inserted a drain into the kidney and packed around it. Tuffier made the first experimental suture of the kidney. Czerny, Porier, and Le Dentu demonstrated that renal suture was practicable. Tuffier passed a needle threaded with No. 3 catgut into the medullary substance of the kidney entirely through the sinus, placing four to six suture points in this way at a distance of 1 centimeter one from another at the start but radiating as they approached the surface.

Israel, Albarran, and Kelley all introduced methods of suture. Pappa not only sutured the kidney itself but made a veritable package of the kidney by passing a heavy thread all around it, both lengthwise and crosswise.

Hagenbach (Suter) passed a long intestinal needle through the thickest part of the parenchyma using a double catgut. Beneath the loops

¹The Department of Urology (James Buchanan Brady Foundation) of the New York Hospital.

²Presented at the Meeting of the Genito-Urinary Section of the New York Academy of Medicine, February 15, 1933.

of these mattress stitches he tied down a piece of fat (corresponding to the tufts of a mattress)

Kuemmel Jr., employed tamponage by making a tissue of resorbable catgut threads which had great haemostatic powers. It worked well on animals but has never been used in human surgery. Rubaschow implanted the nephrotomy wound with fascia lata and fragments of muscle. Cimminata advised using fragments from the sacrolumbar mass, but neither of them made clinical use of their ideas. Joseph has employed this method on human subjects. Federoff completed haemostasis after suture of the renal wound by fixing over the incised edges strips of perirenal fat taken from the capsule. Tschalka and Hilse and Armin (1913) all wrote on the subject of implantation of fatty tissue in closing nephrotomy wounds.

EXPERIMENTAL OBSERVATIONS

The suture material designed expressly for use in this experiment consists of flat ribbons of untwisted gut, 45 to 65 centimeters in length, 1.8 to 2.0 centimeters in width and in thickness no more than that of fine rice paper. Packed in alcohol in the usual type of aseptic catgut tube, it remains thoroughly pliable. Though it shows a tendency to dry rapidly when exposed to air, and when dry is no longer adequately pliable, it may be readily softened again by moistening with physiological saline. In the animal experiments it has been used in hands one half the standard width that is approximately 0.8 centimeter but in the operations on humans the full width has been used. It has in all instances been tied in the same manner as are ordinary types of catgut the width of the material has not interfered with adequate knots, and the tape itself has shown a tendency to twist only over a distance of about a centimeter immediately adjacent to the knot. In no instance have we noted any tendency to slip on the part of the knot. *In vitro* experiments, conducted by the manufacturers have indicated that the tape is absorbable in 4 to 5 days. Up to the present time this has not been confirmed in our observations the tape has been found entirely intact though of lesser tensile strength at the end of 23 days.

In both rabbit and dog the renal pedicle is relatively long and because of this the kidney may be readily marsupialized. The exposure then can be limited to a single muscle splitting incision approximately 6 centimeters in length through which the kidney is easily deliverable. The approach in both animals is retroperitoneal in the dog there is a reflection of visceral perito-

neum on the anterior medial third of the kidney which however, may be easily peeled off. With moderate care therefore it is possible in both animals to deliver the kidney completely, free of adjacent tissue and without injury to the peritoneum. In the human cases, approach has been made through the usual lumbar route.

With the kidney completely exposed straps of kidney capsule each about 0.5 centimeter in width are constructed on anterior and posterior surfaces at both upper and lower poles. If the flat surfaces of the kidney be visualized as divided in equal parts by a line drawn through the hilus, the straps would lie at a point approximately in the center of each half. The straps are produced by two parallel incisions in the kidney capsule 0.4 centimeter apart and about 1.0 centimeter in length the intervening bridge of capsule is stripped away gently by undermining it with a clamp. The direction of these incisions is parallel to that of a line drawn from hilus to pole. The actual length of the strap is decided, of course, by the width of the tape to be used. Through these straps at either pole is threaded a flat tape and the belly of the tape is looped beneath the pole the free ends, then meet across the lateral, convex border of the kidney proper (Fig. 1). Having made these preparations for closure, nephrostomy incision is made through the avascular line of Broedel either with the scalpel or by a strand of catgut. A clamp for grasping the calculus is thrust through into the pelvis and when the stone has been removed the closure can be completed. A small piece of freshly cut fat is introduced into the wound and the cut edges thoroughly approximated by tying the free ends of the suture tape across the line of incision. To eliminate the chance of the suture slipping off the pole of the kidney the long ends of the sutures are then tied together. In the event that this does not entirely close the wound or control the bleeding a third tape, in the form of a figure of eight, is placed beneath either pole and crossed and tied at the midpoint of the convex border immediately over the wound (Fig. 2). In the human cases a small catheter has been left in the nephrostomy to drain the renal pelvis for 3 to 4 days. The wound is then closed in layers with plain catgut. In the animals, all the wounds have been closed without drainage in the humans, in addition to the catheter a Penrose sheath drain in the renal fossa has been left for 4 to 6 days.

In the animal experiments ether anaesthesia was employed. The 4 human cases have been done under spinal novocain anaesthesia the customary dosage has been 150 milligrams.

Davis and Geck, Inc. have been most generous in furnishing an unlimited supply of the material used in these experiments.

THE DATA

In the present series, the procedure has been carried out in 16 instances. The first group of operations, which was chiefly of a trial nature was done upon 6 rabbits. Of this group the first animal died at the conclusion of the operation. This was considered an anesthetic death since there was no other demonstrable cause at autopsy. The second animal died at the end of 5 days, of pulmonary consolidation. The remaining animals made rapid operative recoveries and remained in excellent health they showed no evidence of toxicity ate well and all but one gained slightly in weight. They were sacrificed at the end of 14, 16, 19 and 23 days, respectively. In none was there evidence at any time of suppuration in or urinary drainage from the wound.

The second group represents operations upon 6 dogs. Young animals in good health ranging from 10 to 18 pounds in weight were used. All survived in good health except one which died of general sepsis on the fourth day after operation. At the time of writing, these animals range from 13 to 39 days after operation. All animals but one have evidenced a period of toxicity beginning on the second day after operation and extending through the fourth or fifth. In this period they have been perfectly conscious but disinclined to eat or play. At the end of a week all have been as active and playful and have taken food as well as prior to operation. All the animals but one have, except for the period of toxicity maintained their pre-operative weight. In none has there been suppuration in or urinary drainage from the wound in one there was a small collection of clear serum in the subcutaneous layers of the incision. None of these animals has yet been sacrificed. Nephrotomy for removal of renal calculi with closure by this method has been done very recently in four human cases. One patient has been discharged well the second is now convalescent and the latter two are one week after operation and doing very well.

It has seemed advisable to include in this report brief protocols of the studies to date.

Experiment 1 Closure of Nephrotomy in Rabbits

Operation 1. Right nephrotomy January 24, 1933. Moderate bleeding from kidney wound was adequately controlled by closure. Respiratory death occurred at completion of wound closure. Autopsy findings were negative. The anesthetic was the cause of death.

Operation 2. Animal weighed 3 pounds. A left nephrotomy was done January 24, 1933. There was moderate hemorrhage. Closure with two gut ribbons provided complete hemostasis and approximation. Excellent recovery for 3 days. Stiffles developed on fourth day and animal died on fifth day. Autopsy showed a congested, swollen

kidney evidently in the early stage of repair. There was no evident necrosis of the renal tissue. A slight amount of old blood was noted in the renal fossa. Partial digestion of gut ribbons had taken place and there was diffuse pulmonary consolidation. Cause of death pneumonia.

Operation 3. Animal weighed 4 pounds. A left nephrotomy was done January 26, 1933. The usual closure with two gut ribbons failed to approximate the mid portion of the wound and a third ribbon was placed to close this defect. Bleeding had been moderately severe but was entirely controlled. Recovery was complete and uncomplicated. Animal was sacrificed on the sixteenth day after operation. It then weighed 3½ pounds. The kidney was normal in size, shape, and consistency. There were moderate perirenal adhesions. The gut ribbons were in place and intact. The nephrotomy wound was entirely healed evidenced only by white scar 1 millimeter wide. No evidence of necrosis of renal tissue was noted.

Operation 4. Animal weighed 5 pounds. A left nephrotomy was done January 31, 1933. There was an usual degree of hemorrhage. Closure was done with two gut ribbons. Hemostasis was complete. Recovery was uncomplicated. Animal was sacrificed on twenty third day after operation. It then weighed 5 pounds. The kidney was found in the usual position surrounded by a moderate mass of adhesions. The gut ribbons were intact and in place. The kidney was normal in size, shape and consistency. The nephrotomy wound had healed. A small piece of necrotic fat was still present at the midpoint.

Operation 5. Animal weighed 4½ pounds. A left nephrotomy was done January 3, 1933. There was the usual amount of hemorrhage. Closure was done by two gut ribbons, with complete hemostasis and approximation. Uncomplicated recovery followed. Animal was sacrificed on fourteenth day after operation. Weight was then 4½ pounds. The kidney was surrounded by moderate adhesions. The gut ribbons were in place and intact. The nephrotomy had entirely healed only visible remains were scar 1 millimeter wide and 1 centimeter in length. The kidney was normal in size, shape and consistency.

Operation 6. Animal weighed 5 pounds. A left nephrotomy was done February 17, 1933. There was the usual degree of bleeding. Two gut ribbons were used in closure. Complete hemostasis and approximation were obtained. Uncomplicated recovery took place. Animal was sacrificed on sixteenth postoperative day when weight was 5 pounds. The kidney was surrounded by moderate mass of adhesions. The gut ribbons were intact and in place. The kidney was normal in size, shape, and consistency. The wound was completely healed.

Experiment 2 Closure of Nephrotomy in Dogs

Operation 1. Animal weighed 18 pounds. Intraperitoneal exploration was done, and the peritoneum was closed. Through a retroperitoneal exposure, a right nephrotomy was done February 9, 1933. There was moderate hemorrhage. Two gut ribbons were used in the closure. Approximation and hemostasis were complete. Hypodermic anesthesia was given while animal was on table. Anesthetic recovery was complete. Animal was toxic from third to sixth day after operation, but was subsequently normal. It maintained its original weight, now 30 days after operation.

Operation 2. Animal weighed 8½ pounds. A right nephrotomy was done February 7, 1933. Brief hemorrhage. Closure with two gut ribbons was done. Complete approximation and hemostasis were obtained. Hypodermic anesthesia was administered with animal on table. Recovery from anesthetic and operation was rapid. There was no period of toxicity animal was completely normal in all

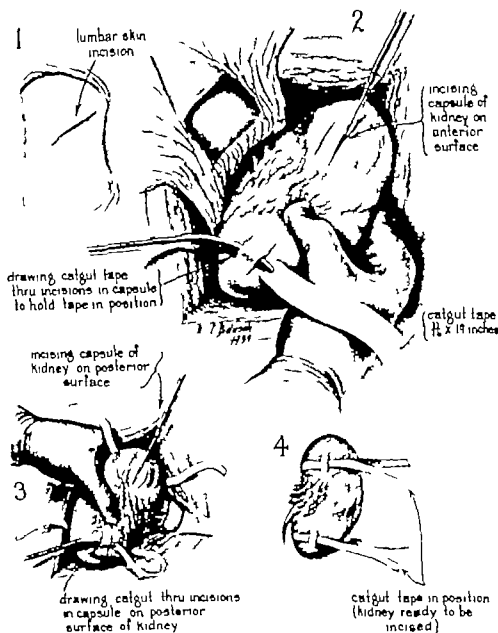


Fig. 1. 1. Lumbar incision extending from the costovertebral angle obliquely down into the loin in such a manner that it is under the branches of the twelfth subcostal nerve and over the branches of the ilio-inguinal and iliohypogastric. 2. Shows the cutting of the loops in the capsule of the kidney and drawing the ribbon gut through the loop thus made. 3. Shows the same sort of loop made on the opposite side. 4. Shows the ribbon gut passed through the loops on each side of both poles of the kidney ready to be tied.

respects. Moderate amount of weight was lost during first 2 weeks. Now 34 days after operation. Weight 80 pounds.

Operation 3. Animal weighed 15 pounds. Left nephrotomy was done February 9, 1933, electro-cutting instrument being used. Hemorrhage was brisk. Closure with three gut ribbons was done, complete approximation and hemostasis. Hypodermoclysis was administered while animal was on table. Anesthetic recovery was satisfactory. Period of toxicity lasted from second to sixth day after operation. Thereafter animal was quite normal maintained original weight. Now 32 days after operation.

Operation 4. Animal weighed 17 1/4 pounds. A right nephrotomy was done February 16, 1933. There was marked hemorrhage. The wound was closed by three gut ribbons, with complete approximation and hemostasis. Hypodermoclysis was given while animal was on table. Satisfactory anesthetic recovery ensued. The period of toxicity lasted from the third to the seventh day after operation thereafter normal. Animal maintains its original weight. It is now 25 days after operation.

Operation 5. Animal weighed 10 pounds. A right nephrotomy was done February 21, 1933. There was moderate

bleeding. The wound was closed with two gut ribbons, with complete approximation and hemostasis. Hypodermoclysis was done while animal was on the table. Satisfactory anesthetic recovery ensued. Animal was extremely toxic on the first day. Autopsy showed massive suppuration involving renal fossa and kidney proper, the nephrotomy incision open and draining, the gut ribbons intact and in place, no peritonitis, and superficial layers of incision free of inflammatory reaction. Cause of death was sepsis.

Operation 6. Animal weighed 13 pounds. A left nephrotomy was done February 25, 1935. There was moderate bleeding. Closure was done with two gut ribbons. Complete approximation and hemostasis was accomplished. Hypodermoclysis was administered with the animal on the table. Recovery from operation was satisfactory. Period of toxicity lasted from second to sixth day after operation, subsequently normal. Animal maintains its original weight. It is now 3 days after operation.

Experiment 3. Closure of Nephrostomy for Renal Calculus

Case 1. The patient is a married salesman, 40 years of age, who presented himself complaining of pain in the back of 4 months' duration. One brother was known to have suffered renal colic; otherwise the family history was irrelevant. The immediate illness dated back 1 year to the onset of painless hematuria, the cause for which was not determined either at cystoscopy or at suprapubic exploration. In the 4 months prior to admission the patient had had repeated attacks of left renal colic at intervals of about 1 week; similar attacks had been suffered on the right side for 3 months. On admission to the hospital, patient was free of pain and the general physical examination was quite negative except for slight residual costovertebral tenderness. The urine was turbid and of 0.02 specific gravity, albumin none, sugar none, but the sediment carried 100 leucocytes with clumps and 35 erythrocytes per high power field. The Kline test and Wassermann reactions were both negative. Analysis of the blood chemistry showed a urea nitrogen of 17 milligrams per cent and a sugar of 9 milligrams per 100 cubic centimeters. The total excretion of phenolsulphophthalein amounted to 35 per cent in 5 1/2 hours. Cystoscopy demonstrated a chronically infected bladder without residual urine and grossly bloody specimens from both ureters. Pyelography demonstrated multiple renal calculi on the right and a large impacted calculus in the lower third of the left ureter.

On December 23, a left ureterotomy was done for the removal of that stone. The operative and convalescent recovery was unremarkable except for an intermittent subcutaneous abscess of the wound at the site of drainage. During the 8 weeks' interval between first and second procedures, the blood urea nitrogen fell from 22 to 8 milligrams per cent, the excretion test with phenalein was increased from 35 to 42 per cent. Divided functional test done 2 days before the second procedure returned 2 per cent of the dye on the right and 5 per cent on the left in 1 1/2 hours after appearance time of 4 minutes and 4 minutes respectively.

Right nephrostomy for removal of the calculi was done February 15, 1935. Anesthesia was provided by spinal novocain. After complete evacuation of the stones, a No. 18 F catheter was left in the kidney pelvis and the nephrostomy wound closed after the manner described. The two gut ribbons were sufficient to provide adequate approximation of the cut surfaces and likewise to establish complete hemostasis. The kidney was returned to its position and supported by a Denning nephropexy. There was no operative shock and the patient was returned to his

room in excellent condition. There was blood tinged urine draining through the catheter for 35 hours after which it became clear and the catheter was removed at the end of 48 hours. For the first 5 days, patient ran a fever which reached 103.6 degrees on two occasions, during this period the patient was clinically toxic. There was only slight discomfort referable to the kidney although there was considerable postoperative distention that responded only sluggishly to usual measures. The Penrose drain to the renal fossa was removed on the sixth day and on the next, after a moderate elevation of temperature, a subcutaneous abscess was opened and the wound irrigated by the Carrel-Dakin method. Patient became afebrile on the sixth day and the Carrel tubes were removed on the twelfth postoperative day. From this point onward the wound granulated rapidly and there was no evidence of urinary leakage. Patient was up in a chair on the sixteenth day after operation. A divided renal function test for comparison, its pre-operative findings was done on the twenty-eighth day and returned 24 per cent of the dye on left and 29 per cent on right in 3 hours after intramuscular injection. There after patient was up and about ward free of complaints.

Case 2. The patient is a married American male of 43 years, who complained of pain in the lumbar region of 5 months' duration. Six years prior to admission patient underwent a right ureterotomy for removal of calculi and subsequently drainage of a perinephritic abscess. During the 3 months immediately prior to the present admission, the patient had experienced three attacks of low back pain associated with urinary frequency, dysuria, and pain referred to the bladder; there was no gross hematuria. The patient had likewise suffered a constant residual pain in the left flank during the same period. The usual physical examination was unremarkable. Laboratory analysis showed the urine to be cloudy and acid in reaction with a specific gravity of 1.028, there was no albumin or sugar, and the sediment showed many white cells in clumps. The blood sugar was 80 milligrams per 100 cubic centimeters, the blood urea nitrogen was 17 milligrams per cent and the total phenolsulphophthalein excretion was 79 per cent in 2 1/2 hours. Cystoscopy revealed an infected bladder without residual urine, divided functional test returned 8 per cent of the dye on the right and 6 per cent on the left over a period of 10 minutes after an appearance time of 4 minutes on both sides. Pyelography demonstrated an enlarged left kidney containing a large staghorn calculus. A smaller stone lying in the pelvis.

On March 1 a left nephrotomy over the lower pole of the kidney was done and the calculi removed. A No. 16 F catheter was left in the renal pelvis and the nephrostomy closed with a single flat gut ribbon. This completely approximated the surfaces of the wound and controlled the hemorrhage equally as well. The kidney was suspended by a Denning nephropexy and the wound closed in layers with plain catgut. After a single Penrose drain had been left in the renal fossa, there was no operative shock and the patient returned to his room in good condition. For the first 45 hours, the patient had marked febrile reaction amounting to 104.3 degrees 1 on the first afternoon. With this febrile reaction, patient became severely distended and required gastric lavage and enemas for relief. Fluids were administered parenterally. Drainage through the nephrostomy tube was blood tinged for 2 days, but clear thereafter beginning on the second day this tube was irrigated 1 ke daily with a solution of urinary antiseptic until its removal on the eighth day. After the fifth day the patient's vital signs remained constantly within normal limits, and he had no subjective complaints.

At the time of writing it is 21 days since operation and the patient is completely satisfactorily convalescent and has

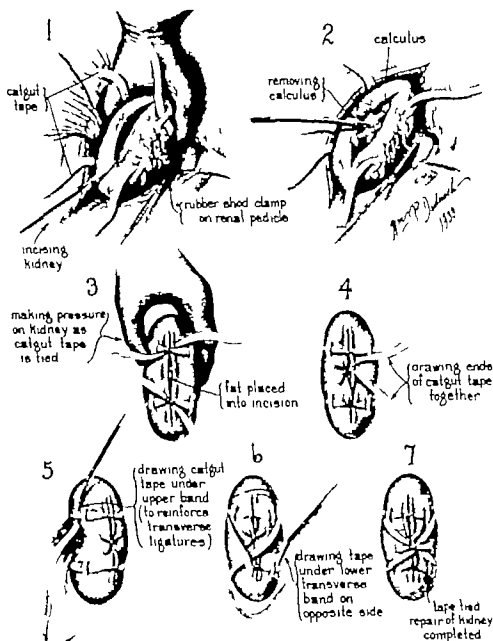


Fig. 2 1 Shows the incision of the kidney cortex along Broedel's line. The ribbon put in place. 2 Shows removal of stagborn calculus from the kidney pelvis. 3, Shows the smooth tying across of the two ribbons, fat having been placed in the incision. 4 Shows the tying of the loose ends of the catgut together holding it firmly in position. 5 6, 7 Show the placing and tying of catgut in such a manner that the middle of the incision is drawn tightly together.

Note.—This method has already been modified in such a manner that the knots are tied on the surface of the kidney away from the cut so that the deposit of urinary salts on the knot will not occur. It is also customary to drain the pelvis of the kidney for a day or two with a tube drain.

no subjective complaints, whatsoever. The urinary drainage ceased on the twelfth day and the wound has closed rapidly.

CASE 3 AND 4. Nephrostomy for renal calculi was done 7 days before writing this article with satisfactory immediate operative recovery.

CASE 5. Nephrostomy was done for drainage of hydronephrosis, with satisfactory operative recovery. Complete protocol will be presented later.

The foregoing facts have demonstrated that a type of closure of kidney wounds designed to eliminate the through and through suture is possible. It has been shown that an absorbable gut suture material which is flat and broad like a ribbon can be so placed about the kidney as adequately to approximate the cut surfaces of a

nephrotomy incision and to control all bleeding completely. In the first instance of 12 operations performed experimentally in this manner 9 animals have lived in good health up to a period of 6 weeks. Of the 3 deaths, one is directly attributable to faulty and imperfect closure of the kidney and the 2 remaining were resultant upon factors not referable directly to the type of operative procedure. The 5 human cases have all recovered admirably well. Of the specimens observed at autopsy after intervals up to 23 days, there has been but one example of imperfect healing and that represented one in which too large a pad of haemostatic fat had been added. In all instances the sutures have been in place and intact. These points emphasize that the procedure is not only possible but that it is permanent in its effect and that the result of such procedure is compatible with life.

Second examination of the specimens removed at autopsy demonstrate that renal wounds closed after this manner heal in an entirely satisfactory way with a minimum of reaction as far as can be noted on gross examination. There is no gross alteration of size or consistency in the specimen.

In the third place, a description of the practical application of the technique has been offered.

Quite aware that the actual evaluation of the method depends upon the functional result in the kidney concerned, the present paper presents only such facts as have been noted to date. It is proposed to expand the experiment to include a detailed report of the effect of the procedure on the functional activity of the organ. Furthermore we are also aware that no microscopic study of the resulting scar is offered in this report. These are in progress and reports are forthcoming.

It has been noted that the suture material, though absorbable *in vitro* in 4 to 5 days, has been found unabsorbed at the end of periods up to 23 days. Since the material is non-chromicized, this fact strongly suggests that the nephrotomy wounds are tightly closed and do not leak. If there had been seepage, the plain gut would certainly have been absorbed in an interval of this length. Further the durability of the material offers confidence that an adequate lasting supporting structure is afforded until such a time as the healing wound has gained its own strength.

At the outset of the experiment, there was some doubt in our minds as to whether there would be sufficient strength in the straps of kidney capsule adequately to support the gut ribbons and to keep it safely from slipping over the poles of the kidney. It is to be noted that in all the autopsy specimens the straps have been entirely intact.

The use of fat as a haemostatic adjunct has been entirely satisfactory in our experiments. In subsequent experiments it is proposed to compare its efficiency with that of bits of muscle.

The regularity of the appearance and duration of the period of toxicity suggests that during this interval there is an inadequate elimination on the part of the kidney. The prompt and complete return to normal thereafter similarly suggests that this phenomenon is temporary and probably dependent upon local oedema within the kidney proper. The absence of infection and urinary drainage once again supports the point of view that the closure of the renal wound is complete and permanent.

CONCLUSIONS

1. Flat ribbon gut can be used successfully for the purpose of closing wounds in the kidney cortex without inserting a needle or suture through the kidney substance.

2. A wound in any part of the kidney cortex may be repaired by this method. The ribbon gut can be held in the proper location by means of small loops of the fibrous capsule.

3. It is well to tie the knot over a part of the uninjured kidney cortex in order to minimize the fibroblastic reaction present about the site of the wound.

4. Closure of a wound in the kidney cortex by this method is an acceptable surgical procedure because first, it provides adequate approximation and, second, since it results in satisfactory anatomical repair of the kidney, and, third, because it is compatible with life and health.

5. It would seem that the principle involved could also be applied to the closure of wounds of the spleen and liver.

The authors wish to express their thanks to Dr. Ralph O. Clock for his many helpful suggestions.

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BENIGN TUMORS OF THE SMALL INTESTINE

REPORT OF TWENTY FOUR CASES

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RECENTLY at The Mayo Clinic, within a period of 9 months, 6 patients came to operation at which time in each case a benign tumor of the small bowel was found to be the cause of the symptoms. This aroused our interest, for it is a universal opinion that any type of neoplasm is rarely encountered in the small intestine. In 1919 Judd noted this rarity in his report of the cases of carcinoma of the small bowel in which operation was performed at the clinic. Rankin and Mayo in 1930 brought the report up to date. A comparative study of the benign tumors, we felt, would be instructive.

MATERIAL

Only cases in which a primary benign tumor was removed from the small intestine at operation and was proved to be neoplastic by microscopic examination of either fresh or fixed tissue are included in this report. For this reason we have omitted such cases as those of accessory pancreatic rest, carcinoid or argentaffine tumor, aberrant endometrial implant or endometriosis, retention or degenerative cyst, foreign body, tumefaction, hematoma, secondary inflammatory polyp and polyposis, pedunculated tumor of the stomach prolapsing through the pylorus, and tumor of the ileocecal valve and Meckel's diverticulum. The tumors of the mesentery have been recently reported by Rankin and Major.

Thirty five cases form the basis of this study, 11 of which have previously been reported. In 1921 Carman presented a hemangioma of the duodenum. Camp reported a myoma of the duodenum in 1924. Balfour and Henderson in 1929 reviewed the benign tumors of the duodenum and added 4 cases. Comfort's extensive study of submucous lipoma in 1931 contained 1 case found at operation. Later in the same year Wellbrock described the second lipoma. In 1932 Larson reported a myxofibroma of the ileum and Dixon and Steward, 2 leiomyomata of the jejunum. Twenty four cases, not previously reported, are briefly summarized (Table I) and thus added to the literature. Henceforward when we speak of 'this series' and when we give statistical

data in the text, we will be considering the inclusive series of 35 cases.

INCIDENCE

At the turn of the century Heurtaux was able to collect reports from the literature of only 30 authentic cases of benign tumor of both the small and large intestine. In 1917 King found reports of 119 only 47 of which were in the small intestine. Golden, in 1928 after a complete review of the literature, found only 17 reports of cases of non malignant tumor of the duodenum. Willis, in 1920 reviewed the records of both the Boston City Hospital and the Massachusetts General Hospital and discovered records of 19 benign tumors in 7,492 reports of necropsy. Raiford (17-18), in a recent report cited 37 benign tumors of the small intestine in 11,500 postmortem examinations, and was able to add 13 from the material in the department of surgical pathology at Johns Hopkins Hospital which included 45,000 surgical specimens.

The 35 cases in this series comprise the total number of benign tumors of the small intestine in the files of The Mayo Clinic which fulfilled the previously mentioned requirements, whereas to date 60 patients have been found to have primary carcinomata of the small intestine.

ETIOLOGY

The etiology, of course, is unknown. Just why the small intestine is relatively free from neoplastic invasion is likewise unsettled. That there is no significant predilection for either sex is illustrated by the fact that 19 patients of our series were males and 16 females. All were of the white race which is roughly in accord with the admissions.

Benign tumors occur among younger persons more often than do malignant tumors. The average age of patients in the present series was 38 years whereas it was 47½ years in the series with carcinoma. The youngest patient was 14 years of age the oldest 70. Almost 30 per cent of the patients were between 30 and 40 years of age.

No etiological factor was discovered in a study of nationality, residence, occupation, or habits



Fig. 1. Case 3. Typical adenomatous polyp of the ileum composed of mucous glands (X 15).



Fig. 2. Case 30. Adenoma of Brunner's glands (X 15).

That 5 parents of 4 patients died from carcinoma is not considered significant.

ADENOMA

Adenomata occurred in 11 of the 35 cases. They were single in 9 cases and multiple in 2. They were sessile in 1 case and pedunculated in 10. All were intraluminal. They varied from 2 millimeters to 5 centimeters in largest diameter. Distribution was throughout the entire small bowel: 5 were found in the duodenum, 3 in the jejunum, and 3 in the ileum. Of the 11 adenomata, 9 were derived from mucous glands (Fig. 1) whereas 2 of those found in the duodenum arose from Brunner's glands (Fig. 2). One adenoma in the duodenum was the cause of severe gastro-intestinal hemorrhage. One polyp in the jejunum and 2 in the ileum caused intussusception.

MYOMA

In the present series, myoma occurred with the same frequency as adenoma. All were single tumors, and none was pedunculated. Six of the 11 myomata were intraluminal, whereas 5 were extraluminal. The smallest was 3 millimeters in largest diameter, whereas the largest measured 6

centimeters. Six were in the duodenum, 4 in the jejunum, and 1 was stated merely as being in the small intestine. Smooth muscle cells were the outstanding element of all of them. Two of the myomata were ulcerated. In both instances they were situated in the duodenum and gave rise to severe gastro-intestinal hemorrhage.

FIBROMA

Fibromata were noted in 6 cases of our series. In each instance they occurred as a single tumor. Two of them were pedunculated and intraluminal; the remainder were extraluminal, 2 being sessile and 2 pedunculated. In largest diameter they varied from 2 millimeters to 10 centimeters. Two were in the jejunum, 1 at the jejuno-ileal juncture, 2 in the ileum, and 1 was stated to be merely in the small intestine. Histologically, only one was a pure fibroma; the remainder of the growths had either undergone myxomatous change, had become hyalinized or calcified to such extent that it was impossible to determine whether the histogenesis was that of myoma or fibroma. In both instances in which the position of the tumor was intraluminal, the fibromata caused intussusception.

TABLE I.—SUMMARY OF TWENTY FOUR CASES OF BENIGN TUMOR OF THE SMALL INTESTINE, NOT REPORTED BEFORE

| Case | Date of operation | Age and sex | History and findings | Operation | Pathology | Follow-up information |
|------|-------------------|-------------|---|--|--|--|
| 1 | 7-22-12 | 37 M | 19 year history of ulcer; obstruction last 6 months, tender right upper quadrant | Posterior gastro-entrostomy; resection of tumor of jejunum | Myoma 3 cm. diameter | Letter 9-22-26 no further trouble |
| 2 | 8-3-16 | 15 F | 1 year history of intermittent intestinal obstruction; sausage-shaped mass | Intussusception reduced, jejunum opened, tumor removed | Pedunculated adenoma, weight 15 gm. | None; well on diet |
| 3 | 4-5-2 | 34 M | 8 year history of intermittent intestinal obstruction; palpable mass | 60 cm. ileum resected, end-to-end anastomosis | Adenomatous polyp 5x3x3.5 cm. | Letter 9-21-25; no further trouble |
| 4 | 6-30-13 | 31 F | 1 year history of obstructive attacks, examination negative | 5 cm. ileum resected, end-to-end anastomosis | Adenomyoma, largest 2.5x3x3.5 cm. | Letter 7-5-26, no further trouble |
| 5 | 9-6-25 | 17 F | 7 year history of repeated severe gastro-intestinal hemorrhages | Entire pyloric cap excised, closed as gastroduodenostomy | Ulcerating hamangioma 4.5x4x3.5 cm. | Letter 12-12-28 no further trouble |
| 6 | 10-22-28 | 24 M | 8 months' history of intermittent intestinal obstruction, much loss of weight | 30 cm. of ileum resected, end-to-end anastomosis | Polyp, 3.5x3.5x3.5 cm. | None; well on diet |
| 7 | 5-21-3 | 41 M | 18 months' history of persistent anemia and ulcer-like dyspepsia | Tumor excised, duodenum reconstructed | Simple submucosal cystadenoma, cm. in diameter | Re-examination 7-2-31 condition excellent |
| 8 | 6-6-2 | 42 F | 8 months' history of palpable movable abdominal tumor | 30 cm. of small intestine resected end-to-end anastomosis | Pure fibroma, 18x8 cm. | Letter 8-12-23; no further trouble |
| 9 | 6-8-16 | 16 F | 1 year history of pelvic malignancy | Exploration, tumor excised from small intestine | Small hyalinized fibroma | None; well on diet |
| 10 | 12-3-10 | 36 F | 4 year history of chronic cholecystitis with cholelithiasis | Cholecystectomy; excision of tumor of ileum | Carcinoma fibrosa | None; well on diet |
| 11 | 3-30-8 | 30 F | 7 year history of duodenal ulcer | Posterior gastro-entrostomy; jejunum opened, tumor excised | 7 polyps, largest 3 cm. in diameter | Intussusceptions and colectomy since; well |
| 12 | 6-17-20 | 48 M | 1 year history of duodenal ulcer | Posterior gastro-entrostomy; excision tumor of jejunum | Fibromyoma, 3 mm. in diameter | Letter 8-23-20 no further trouble |
| 13 | 11-16-21 | 70 M | 10 year history of duodenal trouble with recent obstruction | Posterior gastro-entrostomy; excision tumor of jejunum | Myoma, 5x4x3 mm. | Re-examination 12-29-23, gastro-jejunal ulcer |
| 14 | 8-17-23 | 33 M | 1 year history of gastric ulcer and epiphilia; blood and spinal fluid strongly positive | Cantery excision of ulcer; posterior gastro-entrostomy; tumor of jejunum excised | Polyp (specimen used in sections) | Died 2-24-26; cause unknown |
| 15 | 4-26-24 | 44 F | 8 months' history of carcinoma of body of uterus; uterus enlarged | Total abdominal hysterectomy; excision of tumors of small intestine | Osteochondroma; largest 2.5 cm. in diameter | None; well on diet |
| 16 | 3-9-24 | 25 M | 1 year history of extrajejunal ulcer following gastro-entrostomy | Stomach and duodenum partially resected, posterior Polys | Adenoma, 6 mm. in diameter in duodenum | Letter 10-10-27 no further trouble |
| 17 | 1-15-23 | 15 F | 1 year history of pelvic inflammatory disease; mass in pelvis | Subtotal abdominal hysterectomy; excised tumor small intestine | Fibromyoma, 3 mm. in diameter | Re-examination 10-29-29; sacro-lumbar struts (?) |
| 18 | 8-7-26 | 12 F | Long interval history of attacks of right abdominal pain | Cholecystectomy and appendectomy; tumor of duodenum excised | Myoma 4 mm. in diameter | 7 subsequent admissions; anxiety nervousness, and so forth |
| 19 | 1-12-27 | 31 M | 1 year history of bleeding duodenal ulcer | Cantery excision of ulcer; posterior gastro-entrostomy; excision of tumor of jejunum | Pedunculated fibroma 3 mm. in diameter | None; well on diet |
| 20 | 9-12-27 | 41 F | 6 year history of indigestion and epigastric pain | Multiple duodenal ulcers excised, pyloroplasty | Adenoma of Brunner's glands | None; well on diet |
| 21 | 0-7-29 | 35 M | 6 year history of perforating and bleeding duodenal ulcer | Excision of ulcer and cap of duodenum as gastroduodenostomy | Myoma 16 mm. in diameter | Letter 1-22-30 re current ulcer pain |
| 22 | 5-22-31 | 31 M | 1 year history of carcinoma of ascending colon | Colectomy removal of 5 cm. ileum | Multiple polyps in ileum | Two-stage colectomy since well 5-12-33 |
| 23 | 0-10-3 | 35 M | 8 months' history of partial post-operative intestinal obstruction | Gastroduodenostomy; gastro-entrostomy taken down | Myoma 7 mm. in diameter in duodenum | Letter 6-27-31; no further trouble |
| 24 | 12-8-31 | 30 M | 1 year history of perforating duodenal ulcer; positive Wassermann | Excised half of cap of duodenum gastroduodenostomy | Myoma 4 mm. in diameter in wall of duodenum | None; well on diet |

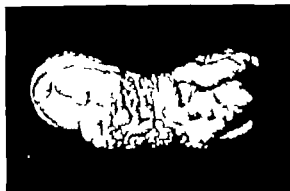


Fig. 3. Pedunculated lipoma of the small bowel (actual size). (Case reported by Weillbrock.)

LIPOMA

Only 2 lipomata were found in the present series. Reports of others tend to show that possibly they are of more common occurrence than this denotes. Morphologically both were soft yellow intraluminal tumors. One was a small sessile lipoma of the ileum whereas the other (Fig. 3) was a pedunculated tumor 3.5 by 2.5 by 2.5 centimeters, in various diameters. Histologically they resembled any normal fatty tissue. The pedunculated lipoma had caused intussusception.

RARER TYPES

Two hemangiomas occurred in our series. Both were sessile and intraluminal, and both were situated in the duodenum. One was 4.5 centimeters, while the other was 5 centimeters in largest diameter. Histologically they were composed of loose connective tissue stroma embodying blood spaces and channels of varying size. One had ulcerated and given rise to severe gastrointestinal hemorrhage whereas the other almost occluded the duodenum, giving rise to symptoms of obstruction.

Only 1 cyst was found which could be considered neoplastic. This was a simple, submucous, multilocular cystadenoma 2 centimeters in diameter occurring in the duodenum. Its living membrane was composed of cuboidal epithelial cells.

In 1 case there were three intramural adenomyomata of the distal part of the ileum, ranging in diameter from 1.5 to 2.5 centimeters. They were so grouped together that they caused partial obstruction. Their structure was typical.

Broders contends that fibrous tissue, wherever it exists in the body may be the seat of origin of cartilaginous or bony tumors. If this is true the subserous osteochondromata in Case 15 (Fig. 4)

were primary tumors of the small bowel, although no similar case reported in the literature has come to our attention.

SYMPTOMS

In 18 cases certain symptoms were present referable to the tumors found at operation. In the remaining 17 cases, the tumors were found incidentally in the course of intra-abdominal operations. The following observations are therefore, limited to the former group of cases.

The chief complaint in all but 1 case was referable to the abdomen. In 8 cases it was abdominal pain in 3 each, stomach trouble and hematemesis in 2 palpable tumor and in 1 case melena. The chief concern of the patient in Case 7 who was found to have both pernicious anemia and a cystadenoma was anemia.

In duration the symptoms varied from 2 months to 35 years, averaging 8 years, whereas for the series of carcinoma it averaged 14 months.

It was surprising to find that symptoms were essentially those of the existing complications. Obstruction in one form or another occurred in 50 per cent of the cases in which there were symptoms. In two-thirds of the cases with obstruction symptoms were caused by intussusception, whereas in the remainder they were due to encroachment of the growth on the lumen. Half of the tumors which caused intussusception were found in the jejunum and half in the ileum. The obstruction from intussusception was usually acute, complete, and intermittent, although obviously in the chronic form it was only partial. The symptoms in all cases of intussusception were strikingly similar. Most patients had had good health until the dramatic onset of a terrific, stabbing cramp-like pain, usually described as being in the 'pit of the stomach,' and not infrequently doubling the patient up. In some cases a cathartic initiated the attack. Practically all patients described a knot or lump having formed in the abdomen. Nausea, extreme vomiting, distention, gurgling, obstipation, and fever followed. Relief was finally obtained by massage of the lump, passage of gas or feces, application of heat, or administration of opiates.

The obstruction due to encroachment on the lumen by the tumor was always incomplete, and usually both progressive and chronic. Symptoms lacked the sharply defined, intermittent characteristics of intussusception. The symptoms were of longer duration and the onset was insidious. The patients had not had good health prior to the first attack of obstruction. Constipation had long since set in and indigestion, often of the ulcer type especially in the presence of duodenal

tumors, had made its appearance, but, sooner or later, abdominal cramps and obstipation, with or without vomiting developed.

Gross hemorrhage occurred in 4 of the 18 cases the tumor in each instance was in the duodenum. It was gastric in 1 case intestinal in 1 and both gastric and intestinal in 2 cases. The symptoms were typical of descriptions in textbooks in each type.

It is interesting that 2 patients complained of nothing except the palpable tumor within the abdomen. Both of these tumors were large extraluminal growths yet they were just beginning to encroach on the lumen of the bowel.

GENERAL EXAMINATION

In 2 cases during attacks of obstruction caused by factors other than intussusception physical examination revealed abdominal distention and rigidity and in 1 case each, visible peristalsis and borborygmus. A sausage-shaped mass was noted in 4 of the 6 cases of intussusception. Between or just following attacks of obstruction, residual tenderness was elicited in 5 cases, and evidence of recent loss of weight was visible in 4. The weakness and anemia were noticeable in 2 of the 4 cases of hemorrhage. The tumor was definitely palpable in three instances.

DIAGNOSIS

Röntgenological examination offers the only means of positive pre-operative diagnosis of benign tumors of the small intestine, and despite the fact that Waters, in 1930, was able to find in the literature only 3 instances in which roentgenological diagnosis had been made of such a condition, in the present series the roentgenologist reported benign tumors of the duodenum in 5 cases, and of the ileum in 1 case.

The extensive reviews on intussusception of Eliot and Corcoran, Watts Willis and others (12, 15, 16) demonstrate that the greatest single cause of intussusception of adults is a benign tumor in the small bowel. In the present series intussusception occurred in 17 per cent of the total series and in 33 per cent of the cases in which there were symptoms, whereas in Rankin and Mayo's series of 55 cases of carcinoma of the small bowel it occurred only twice (3.6 per cent). It is, therefore, safe to assume the presence of a benign tumor, if intussusception is found affecting an adult.

In the 10 cases of duodenal tumor a diagnosis of duodenal ulcer was made in 4 and an associated ulcer was found in 2 of them. However, the symptoms that led to a diagnosis of ulcer were



Fig. 4. Case 15. Section from the osteochondroma of the small intestine, demonstrating both bone and cartilage in the same microscopic field ($\times 115$).

probably caused by tumor in the 2 others. In 1 case a tentative diagnosis of chronic appendicitis was made, and in another, a diagnosis of Meckel's diverticulum. It is instructive to note that the tumor in Case 8 was thought to be a pedunculated fibromyoma of the uterus.

Four patients had undergone irrelevant intra-abdominal operations before admission without relief of symptoms. These operations consisted of appendectomy in 2 cases, cholecystectomy in 1 and myomectomy in 1.

TREATMENT

Extraluminal tumors unless of such size that their removal endangered the blood supply to the intestine were either shelled out or dissected usually without cutting the mucous membrane. This was done in 6 cases. Small intraluminal tumors were removed by an elliptical incision of the intestinal wall, the tumor being included in the ellipse. This applied also to pedunculated intraluminal tumors in which the attachment of the pedicle was definitely determined by palpation or by noting umbilication. If the attachment could not be determined, or if the base of the

pedicle was large, an incision was made opposite the tumor the pedicle was clamped and ligated, or sutured and the tumor was excised. Larger intramural tumors were removed by making a straight incision and enucleating the growths. In a majority of cases, incisions were closed transversely to increase the size of the lumen. One of these methods of excision was employed in 19 cases. In 10 cases very large tumors involving the wall of the intestine, thickened bowel that had undergone repeated invagination or bowel that had become gangrenous from intussusception, was resected with the tumor and subsequent anastomosis was resorted to.

The entire series of 35 patients underwent operation without a death and all were dismissed in satisfactory condition. Follow up data were received in 14 of the 18 cases in which there were symptoms. The interval after operation varied from 3½ months to 18 years. Eight patients reported perfect results, 5 had minor irrelevant complaints, whereas one reported pain characteristic of ulcer nausea, and one attack of inconsiderable hæmatemesis. This last patient was one of the two who had both an ulcer and a tumor of the duodenum. She was advised concerning diet for ulcer and we have received no further complaints.

SUMMARY

Thirty five cases of true primary benign tumor of the small intestine are reviewed. Eleven have previously been reported, the remainder are briefly summarized thus adding 24 cases to the literature on the subject. That these tumors are exceedingly rare is demonstrated by the fact that this series represents the total number of such tumors surgically removed at The Mayo Clinic and to date this is the largest series of its kind reported in the literature. Benign tumors were found to be twice as rare as primary carcinomata of the small bowel and afflicted younger patients. Almost 50 per cent of the patients were between 30 and 40 years of age. Adenomata and myomata were equally common in occurrence and together they comprised approximately two-thirds of the total number of tumors. Half of the remainder were fibromata. The very rare types included lipoma, hæmangioma, cystadenoma, adenomyoma, and osteochondroma. The last, as far as we know is the first tumor of this type to be reported as having been found in the small intestine. Symptoms accompanying some of the tumors of the duodenum were like those found in cases of ulcer in other cases, the history was of hæmorrhage. Symptoms of tumors in the jejunum and ileum were essentially those of obstruction

Positive pre-operative diagnosis was made possible by roentgenological examination in 6 cases. Presumptive diagnosis can best be made on the basis of the following evidence characteristic of intussusception in an adult, progressive obstruction of the small bowel gastro-intestinal hæmorrhage, palpation of a freely movable abdominal tumor or any combination of these.

The treatment is distinctly surgical. Not any of the 35 patients who were operated on died, although the lumen of the intestine was opened in 19 cases and resection of the bowel, with anastomosis, was employed in 10 other cases. Follow up investigation demonstrated the obvious permanence of surgical cure.

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INJURIES OF THE MEDIAN NERVE IN FRACTURES OF THE LOWER END OF THE RADIUS¹

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INJURIES to the median nerve in fractures of the lower end of the radius are generally regarded as of infrequent occurrence. In spite of the great frequency of fractures at this site, it is surprising how seldom involvement of the nerve is mentioned as a possible complication. Several of the leading textbooks on fractures, on orthopedic surgery, and on the peripheral nervous system have been consulted but no specific mention of this complication has been found, except that it is referred to as an unusual injury with but little space devoted to a description of the mechanism of production. Jeanbrau states that nerve lesions, particularly those of the median are rare in isolated cases of the fracture of Pouteau, and Wilson in his textbook mentions such involvement as a possibility.

We have no means of estimating the frequency of this complication in fractures of the lower end of the radius and we find no mention of it in the reported statistics of large series. Lewis and Miller in 1922 surveyed mainly from the literature 239 cases of peripheral nerve injury associated with fractures. In this series 5 occurred in fractures of the lower third of the bones of the forearm. Of these 5, 3 involved the ulnar nerve 1 in fracture of the lower third of the ulna and 2 in fractures of both bones. The 2 remaining involved the median nerve in fracture of the lower third of the radius.

As a contrast, with regard to ulnar nerve injuries in Colles fracture we have the statement of Cotton that they are not infrequent. He states that he has twice seen a total tearing of the ulnar nerve when the fracture was accompanied by luxation of the head of the ulna, but more commonly with secondary neuritis mainly of sensory type resulting from constant irritation of the

nerve by the constantly slipping head. The latter he says, in minor degree is not rare, and adds that he has seen a number of cases in which this was the major factor.

We should like to record here that it is our opinion that injury to the median nerve in fractures of the lower end of the radius is more frequent than heretofore supposed, especially a variety of injury due to treatment of such frac

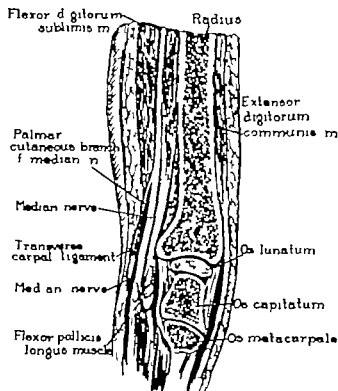


Fig. 1. Sagittal section to illustrate relation of median nerve in the region of the wrist. Note the close relationship which the transverse carpal ligament and the prominent lower anterior border of the radius bear to the median nerve.

¹From the Divisions of Orthopedic Surgery and Applied Anatomy University of California Medical School, San Francisco. Read before the Pacific Coast Surgical Association at meetings in San Francisco and Del Monte February 22 to 25, 1931.



Fig. 2.

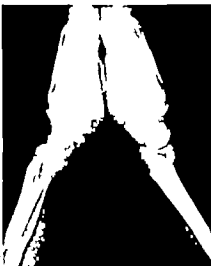


Fig. 3.



Fig. 4.



Fig. 5.

Fig. 2. Case 3. January 26, 1931. Illustrating pronounced trophy of bones of hand and wrist.

Fig. 3. Case 3. January 26, 1931. Lateral view both wrists showing malunion with marked posterior tilting of articular surface of the radius on the right.

Fig. 4. Case 3. May 10, 1931. Position of acute palmar flexion found necessary to maintain degree of correction secured by osteotomy.

Fig. 5. Case 3. June 1, 1931. Final position after osteotomy.

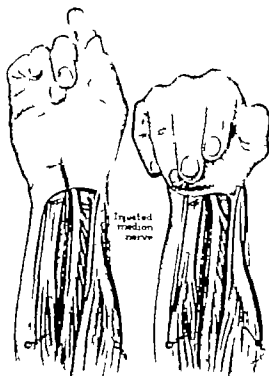


Fig. 6. Effects of injection of sheath of median nerve in palmar flexion and in extension. On the right, arrest of colored solution at proximal border of transverse carpal ligament. On the left, passage of solution into palm of hand.

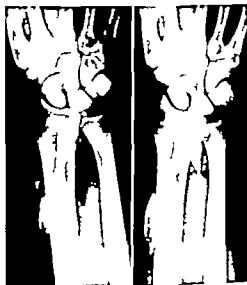


Fig. 7, left. Roentgenogram after injection of the sheath of the median nerve with lipiodol with the wrist held in acute palmar flexion. The solution is arrested at the level of the transverse carpal ligament.

Fig. 8. Roentgenogram after injection of the sheath of the median nerve with lipiodol with the wrist held in extension. In this position the solution flowed freely into the palm of the hand. Dispersion of the solution into the surrounding tissues was due to rupture of the sheath of the nerve during the injection.



Fig. 9.

Fig. 9. Case 5. July 27 1931. Roentgenograms showing the posterior displacement of lower fragment of radius before reduction was attempted. (Courtesy of Dr F. G. Linde.)

Fig. 10.

Fig. 10. Case 5. July 28, 1931. Failure of reduction by manipulation.

Fig. 11.

Fig. 11. Case 5. August 12 1931. Showing postoperative reduction. Lateral view was unfortunately lost.

tures in acute palmar flexion. Our impression is that, as the fracture proper enlists the attention of both surgeon and patient and any disability which follows is ascribed to that cause, a lesion to the nerve must frequently be overlooked. Moreover we know that in these fractures the injury to the median nerve is often incomplete and transient and may therefore never be recognized. Yet, in our experience, there have been a number of cases of sufficient severity to cause marked changes in sensation and motor power of the hand. In these more complete lesions the functional disturbance due to nerve injury has been far more important than that which resulted from the fracture. In certain instances neurolysis has been required in order to prevent a permanent crippling condition of the thumb index, and middle fingers.

It is the object of this paper therefore, to emphasize that in all fractures of the lower end of the radius a thorough examination should be carried out to determine whether there is involvement of the median nerve as a primary injury. Further we wish to lay special emphasis on a variety of median nerve injury which we believe to be brought about specifically by the treatment of Colles fractures in palmar flexion even when good reduction of the fracture has been obtained—a variety of nerve injury which we believe so far to be unrecognized. We shall also show that injuries to the median nerve, caused by palmar

flexion, are due to direct pressure on the nerve between the proximal margin of the transverse carpal ligament and the distal anterior border of the radius. This fact we have determined by anatomical dissections and injections of the sheath of the median nerve. It is interesting to note that Fairbanks, in discussing a recent paper of Platt's on Colles fracture mentions the trophic hand which occasionally follows such fractures but expresses his ignorance of its pathogenesis. The writers or their colleagues have during the past two years, met with more than a half dozen cases of fracture of the lower end of the radius associated with involvement of the median nerve. In the majority of these the injury to the nerve could be directly ascribed to fixation of the fracture in palmar flexion.

LITERATURE

It would seem pertinent at this point, to survey some of the more important articles on this subject. Though we have not been able to analyze all of the extensive literature written on these fractures yet we have reviewed available articles dating back to 1835.

The earliest recorded case we have been able to find is that of Gensoul's, 1835 in which primary injury to the nerve occurred. Paget, in his treatise on *Surgical Pathology*, 1854, quotes an interesting case of Hilton's in which the median nerve was secondarily involved consequent on a fracture of



Fig. 2

Fig. 2. Case 6. May 22, 1932. Showing deformity of lower end of radius prior to reduction.



Fig. 3

Fig. 3. Case 6. May 25, 1932. Roentgenogram



Fig. 13

showing failure of reduction by the first manipulation.



Fig. 14

Fig. 14. Case 6. May 25, 1932. Good reduction and position of acute palmar flexion used for fixation.



the lower end of the radius which had healed with an excessive quantity of new bone. Such isolated case reports which are found mostly in French publications were collected by Blecher in 1908. He found 9 cases and added 1 of his own. Two years later Kirchheim wrote on this subject as a thesis for the Friedrich Wilhelm University, Berlin, commenting upon the work of Blecher and adding 4 further cases, mostly from the literature. Since the papers of Blecher and Kirchheim we find very occasional reference to the fact that this nerve may be injured in such fractures.

Dickson illustrates a case with marked trophic disturbances and causalgia due to compression of the median and ulnar nerves in a Colles' fracture.



Fig. 15, left. Case 8. February 5, 1933. Position of fragment before reduction. (Courtesy of Dr. F. J. Sullivan.)

Fig. 16. Case 8. February 6, 1933. Acute palmar flexion used for immobilization after reduction.

Neurolysis was performed a year after injury with disappearance of all pain and trophic symptoms. This is the only case we have found in which both nerves were involved.

Other cases from the literature will be commented upon under the appropriate heading.

In the literature we have found no reference to injuries of the median nerve thought to be due to treatment, and it should be remembered that it is only during the last decade that the position of palmar flexion and ulnar deviation (the so-called Cotton-Loder position) has become generally popular with the profession.

CLASSIFICATION OF INJURIES TO THE MEDIAN NERVE IN FRACTURES OF THE LOWER END OF THE RADIUS

The special injuries of the median nerve which form the subject of this contribution may be divided somewhat arbitrarily into four clinical groups: (1) primary injuries, (2) secondary injuries, (3) late or delayed involvement, (4) injuries associated with treatment in palmar flexion.

The majority of these injuries are incomplete and may be classed as cases of traumatic neuritis.

Before proceeding to a consideration of these clinical types and the illustrative cases, a brief outline of the anatomy in the region of the wrist will be useful.

ANATOMY OF MEDIAN NERVE AT WRIST

The anatomical considerations of the median nerve at the wrist joint are of particular importance in explaining the special features and types

of involvement which are met with when this nerve is injured in Colles' fracture. The median nerve is accompanied in its passage from the forearm to the palm of the hand by the *arteria mediana*. This vessel on occasion is of substantial size and sometimes may assume such proportions as to replace the radial or ulnar artery. It anastomoses with recurrent branches of the superficial volar arch. The nerve is not directly related to the volar surface of the radius but is separated from it by the fleshy mass of the pronator quadratus muscle and by the tendon of the flexor pollicis longus muscle (Fig. 1). The pronator quadratus muscle serves to protect the nerve from fragments of this bone. Superficial to the nerve in the proximal part of its course is the flexor digitorum sublimis and the nerve is closely adherent to the deep surface of this muscle. At the wrist joint the nerve suddenly alters its course becoming more superficial and lying on the ulnar side of the tendon of the flexor carpi radialis, behind or on the radial side of palmaris longus. Just before passing into the hand deep to the transverse carpal ligament, it often assumes such a superficial position as to be readily palpable. So superficial may it be at this point that it may be divided by an apparently trivial cut through the skin of wrist without severance of the attendant tendons. At this point the nerve gives off its palmar cutaneous branch which supplies the proximal part of the palm of the hand with sensation. Passing deep to the transverse carpal ligament and overlapped by the lateral part of the synovial flexor sheath it enters the palm and divides into medial and lateral divisions. Through the medium of these two divisions the nerve supplies the muscles of the thenar eminence, two or more lumbricals and the lateral $3\frac{1}{2}$ fingers with sensation on their palmar aspect and on the more distal part of their dorsal aspect. This area of sensory supply is subject to considerable individual variation, for the median nerve anastomoses to a variable extent with the ulnar and sometimes radial nerves connections which may explain the variability in both motor and sensory findings.

It is of the greatest importance to remember that the median nerve carries with it most of the sympathetic nerve supply of the hand, an anatomical fact associated with frequency of trophic disturbances found when this nerve is injured.

1. PRIMARY INJURIES TO THE MEDIAN NERVE IN FRACTURES OF THE LOWER END OF THE RADIUS

Primary injuries of the median nerve are those which occur at the moment of fracture and would

seem to be rare. The nerve is protected by the fleshy mass of the pronator quadratus muscle and therefore its direct severance by sharp ends of bone is unlikely. The only cases we have been able to find in which the median nerve was directly involved by the bone were those reported by Gensoul and Billroth. Gensoul's patient was one with fracture of both bones of the forearm. Death occurred from tetanus and at autopsy the median nerve was found strangulated between the ends of the radius. In Billroth's case of an open comminuted fracture of the lower end of the radius, the nerve was found to be partially severed. We find no recorded case in which complete severance of the nerve has occurred.

In the majority of instances of primary injury reported the nerve has been damaged indirectly from the pressure of a markedly displaced fragment or shaft often combined with hyperextension of the hand as a result of the fall, so that the nerve is drawn taut over the projecting fragment (Kirchheim). Owing to the very superficial position which the nerve occupies at the wrist before passing down to the transverse carpal ligament, it may suffer a mild contusion with transient involvement of trifling character. Should the fracture be complicated by a laceration of the wrist the nerve might easily be divided.

It would seem difficult in many instances to separate primary from secondary injuries of the nerve, as such lesions may easily escape notice at the time of fracture and only be detected several weeks later for it is the bony trauma which dominates the picture. This is particularly the case in partial injuries to the median or ulnar nerve as there is no obvious incapacity. Contrast the readily recognized wrist drop when the radial nerve is involved.

We have met with no case which falls in this group.

SECONDARY INJURIES TO THE MEDIAN NERVE IN FRACTURES OF THE LOWER END OF THE RADIUS

The majority of reported cases of injury to the median nerve in fractures of the lower end of the radius are of the secondary type. We have indicated above however that it is difficult to assign a nerve injury to its appropriate chronological group. It is said that they may be distinguished by the clinical differences which they exhibit. Primary injuries by the abruptness of onset and completeness of nerve block, secondary by the slowness of onset and by the initial incomplete nature of the lesion. But these distinctions are seldom clear and each individual case requires the

closest clinical scrutiny. It is possible that an injury initially primary may pass into the secondary class. Secondary injuries to the nerve, in the majority of circumstances, however are due to the continued pressure of an unreduced or incompletely reduced bony fragment or to excessive callus formation, or to both. The effect is to produce a bridge across which the median nerve is tightly strung. The combined tension and friction set up by the movements at the wrist joint inflict repeated traumata on the nerve and result in the onset of a neuritis. This is a well known cause of nerve injury elsewhere, as has been abundantly demonstrated.

Hilton's case quoted by Paget, is the first reported case of secondary neuritis of the median nerve following fracture of the lower end of the radius and is so typical of the above mechanism as to merit re-quoting.

A man was at Guy's Hospital who in consequence of a fracture of the lower end of the radius, repaired by an excessive quantity of new bone, suffered compression of the median nerve. He had ulceration of the thumb and fore and middle fingers, which resisted various treatment, and was cured only by so banding the wrist that, the parts on the palmar aspect being relieved, the pressure on the nerve was removed. So long as this was done, the ulcers became unremedied well, but as soon as the man was allowed to use his hand, the pressure on the nerves was renewed, and the ulceration of the parts supplied by them returned.

On analysis of these cases, clinical phenomena occur on the average between 1 and 2 months after the fracture. Physiological nerve block ensues and it may be complete or incomplete. There is a variable wasting of the thenar musculature but motion must be carefully analyzed because the functional loss of the paralyzed muscles may be obscured by the compensatory action of other muscles. There is usually anesthesia or paresthesia over some part of the median nerve distribution, almost constantly over the index finger and trophic changes in the skin are not uncommon.

We report below a fairly typical example of secondary neuritis following a fracture of the radius.

CASE 1: Mrs M F aged 47 years (Dr F G Linde) sustained a fracture of the right wrist on February 21, 1913. Roentgenograms disclosed a comminuted, impacted fracture of the lower extremity of the radius and fracture of the ulnar styloid. There was no involvement of the median nerve. As this patient had had a previous heart attack and the position of the fracture was fair reduction was not advised. The fracture was immobilized by splints which were removed in 3 weeks and physiotherapy was instituted.

Four weeks after injury the patient commenced to complain of numbness in the thumb, index, and middle fingers. As symptoms were increasing in severity she was seen by Dr Edward Fleming who performed neurectomy, months

after injury. At operation a definite thickening of the median nerve and sheath, at or just above the level of the wrist, was found. An injection into the sheath flowed down to the constricted point of the nerve. The sheath of the nerve was split and the wound closed.

On the first day after operation, there was improvement in sensation. Progress was satisfactory but when last seen, 6 months after injury there was still considerable limitation of motion in the fingers. Sensation was much improved but numbness of the fingers remained.

3. LATE OR DELAYED INVOLVEMENT OF THE MEDIAN NERVE IN FRACTURES OF THE LOWER END OF THE RADIUS

Late or delayed median nerve palsy may occur as a rarity in association with fracture of the lower extremity of the radius. This is illustrated in the following case. The features are essentially similar to those of delayed ulnar palsy which occurs as a remote sequela of fracture of the lateral condyle of the humerus.

CASE 2: Male, aged 35 years, laborer seen during routine treatment for syphilis. History given was that some 10 years previously he had sustained a fracture of his left wrist. For the past few months he had noticed numbness of the fingers which he was certain was of but recent origin. On examination there was little or no functional disability but evident deformity at the lower end of the radius. Anesthesia or hypoesthesia existed over the median nerve distribution. There was obvious wasting of the thenar eminence and a slight trophic disturbance of the skin. The median nerve was not palpable at the wrist. Roentgenograms revealed an old Colles' fracture incompletely reduced with a prominence on the anterior aspect of the radius. Patient discontinued antisyphilitic treatment and, as often happens with this class of case, he was lost sight of.

Lewis and Miller report a similar case of Phemister's in which delayed involvement of the nerve occurred. The patient was a doctor who sustained a reversed Colles' fracture of the right wrist which had been imperfectly reduced. There was anterior displacement of the lower fragment. Paresis of the median nerve occurred 18 years after the accident with atrophy of the thenar eminence and moderate hyperesthesia. The changes in the nerve were quite definitely associated with the displacement of the lower fragment.

De Rouville reports a third case of a male, aged 53 years, who, following a fracture of the radius, developed a late paralysis of the median nerve. At operation a pseudo-neuroma, three times the normal size of the nerve, was found. The end-result was not given.

4. INJURIES ASSOCIATED WITH TREATMENT OF FRACTURES OF THE LOWER END OF RADIUS IN PALMAR FLEXION

The possibility of severe damage to the median nerve by a fixed position of palmar flexion was

brought rather forcibly to the attention of one of us during the treatment of a patient whose history, clinical findings, and treatment are as follows:

CASE 3. Mrs. E. W. aged 45 years, sustained a Colles fracture and a fracture of the styloid process of the ulna on November 13, 1930. Early treatment consisted of reduction of the fracture and immobilization for 7 weeks followed by physiotherapy to restore motion of the wrist and fingers. Two months after injury January 26, 1931 she was referred for consultation because progress was unsatisfactory.

Examination disclosed a mal-united fracture with posterior tilting of the articular surface, obliteration of the anterior concavity of the lower radius, and a very marked restriction of motion in the wrist and fingers. Roentgenograms (Figs. 2, 3) January 26, 1931, showed faulty union with marked atrophy of the bones of the hand.

The treatment advocated was to discard splints and continue with heat and exercises. After an interval of 3 months, on April 24, 1931, very little improvement was noted, and therefore correction of the deformity by osteotomy was advised.

On May 13, 1931, an osteotomy through the site of fracture was performed. To correct the posterior tilting and maintain the articular surface of the lower end of the radius at right angles to the long axis of the shaft, a position of marked palmar flexion was necessary. In this position the hand was immobilized by anterior and posterior splints held by a single plaster-of-Paris bandage (Fig. 4).

On the day of operation the patient complained of severe pain in the entire hand. The circulation and movement of the fingers, however, was good. The day following operation she complained of numbness of the fingers, therefore the plaster was split on both sides and no constriction or pressure was noted on the anterior and posterior aspects of the wrist and hand. It was thought at this time that the numbness and lack of normal sensation was due to the position of palmar flexion, and anyone can determine for himself that maintenance of this position is accompanied by considerable numbness in the fingers. Two days after operation the patient stated that the pain and numbness of the fingers was more marked and for the first time was localized to the thumb, index and middle fingers. It was then that suspicion arose that the cause of the disturbance was due to pressure against the median nerve. Consequently the plaster splints were freed further and the position of palmar flexion decreased by padding of the palmar aspect of the hand and wrist. At this time we were able to carry out a more complete examination which disclosed loss of sensation over the palmar surface of the thumb, index, and middle fingers and loss of power in the small muscles of the thumb. Inasmuch as there was no evidence of pressure of splints, as shown by the condition of the skin on the anterior surface of the hand and wrist, we realized that an injury to the median nerve had occurred in some other way. Our opinion was that this was directly connected with the position of marked palmar flexion. Therefore this position was gradually decreased until at the time of her discharge from the hospital on June 1, 1931, 2½ weeks after operation, anterior and posterior splints were worn with the wrist in about 15 degrees of palmar flexion. We had hoped to maintain correction of the deformity secured at operation but we were not so fortunate as disclosed by the roentgenograms taken on June 1, 1931 (Fig. 5).

On June 18, 1931, about 5 weeks after the operation for correction of bony deformity, the patient was seen in consultation with Dr. Howard Naffziger. Up to this time there had been no improvement in the condition of the muscles

and sensation supplied by the median nerve. There was marked tenderness directly over the nerve, just above the level of the wrist. A diagnosis of a complete lesion of the median nerve was made and exploration advised.

On June 23, 1931, an operation was performed by Dr. Naffziger. An incision on the anterior aspect of the wrist showed considerable fibrosis in the region of the median nerve. More careful dissection disclosed scar tissue involving chiefly the sheath of the nerve, but also extending into its substance. An injection of salt solution distended the nerve sheath and showed that the major portion of the nerve fibers remained intact. The scar was therefore excised from the surrounding tissues and sheath of the nerve, and the wound was closed with silk sutures to the deep structures and the skin. The convalescence from this operation was uneventful and the wound was healed in 10 days. Physiotherapy was begun early with careful splinting to maintain the relaxed position of the small muscles of the thumb.

On August 12, 1931, 7 weeks after neurolysis, an improvement in the sensation of the hand was noted. On November 1, 1931, about 4 months after neurolysis, there was almost complete return in the function of the small muscles of the hand. There remained however marked disturbance in sensation.

On September 6, 1932, about 14 months after operation the examination showed almost complete restoration of sensation to touch and pain with only slight atrophy of the muscles of the thenar eminence. The patient did complain, however, of some hyperesthesia of the thumb and index finger and stated that it was difficult for her to pick up fine objects.

This patient is therefore a striking illustration of a complete lesion of the median nerve produced by marked palmar flexion following osteotomy for correction of the deformity in a mal-united Colles fracture. This case led to dissections and finally to injections of the sheath of the median nerve to show its intimate relationship to surrounding structures. That this lesion was produced by pinching of the median nerve between the superior margin of the transverse carpal ligament and the anterior border of the lower radius was thus demonstrated in a convincing manner.

ANATOMICAL MECHANISM OF INJURY TO THE MEDIAN NERVE IN PALMAR FLEXION OF THE WRIST

There are two special features in the anatomy of this region which render the median nerve particularly vulnerable in the hyperflexed position especially if the bone be fractured or displaced. First, owing to the sudden change in direction of the median nerve, immediately proximal to the wrist joint from a deep to a more superficial position it is relatively fixed and this lack of mobility prevents it from retreating from the oncoming parts in acute flexion. Second, the proximal margin of the transverse carpal ligament is sharp and resistant and lies in close proximity to the prominent anterior border of the distal end of the radius. Acute flexion, even under normal con-

ditions, pinches the nerve between these two structures as anyone who cares to do so may prove for himself by holding the wrist in acute flexion for any length of time. The tension in this region from the swelling and edema attendant on the fracture must render this mechanism even more effective. Injections of the sheath of the median nerve with solutions of Berlin blue and lipiodol were made with the hand held in various positions. It was found that if the hand were held in acute flexion, with some degree of ulnar deviation the solutions were invariably arrested at a point opposite the proximal border of the transverse carpal ligament, whereas, under the same pressure if the hand were held in moderate flexion or extension the injections flowed easily into the palm of the hand and in some instances even along the terminal branches of the nerve. These experiments were carried out a number of times, always with a similar result (Figs. 6, 7 and 8).

FURTHER CLINICAL OBSERVATIONS ON INJURIES TO THE MEDIAN NERVE DUE TO TREATMENT

Believing at this time that similar cases to the one above cited were rare in fractures of the lower end of the radius, we were surprised to see a second patient with involvement of the median nerve evidently produced in the same manner.

CASE 4. S. W. female, had sustained a Colles' fracture on April 24, '91. The fracture was reduced at once and immobilized in plaster for 6 weeks. Three months after the injury a diagnosis of incomplete reduction of the fragment was made and on July 20, '91, osteotomy was performed with immobilization of the hand in acute palmar flexion. W. first saw the patient about 6 weeks after operation and she stated that following the latter there was a marked swelling of the hand with numbness of the index finger and thumb. The plaster cast was removed in 3 weeks but no X-ray plates were taken after operation. At this time the patient complained of a marked hyperesthesia and some loss of sensation in the thumb and index finger, also weakness of the muscles of the hand. She stated that sensation was improving gradually. Examination disclosed marked thickening of the tissues about the wrist with limitation of motion of the joint in all directions. The thumb, index, and middle fingers were of a mottled, reddish color and the sensory change was one of hyperesthesia, particularly over the thumb and index finger. Roentgenograms showed incomplete reduction. This patient lived in Colorado and had to return there once for further care.

We were of the opinion that this was a second case of Colles' fracture with an incomplete lesion of the median nerve which was showing definite signs of recovery.

We also learned at this time through the courtesy of Dr. F. G. Linde, of a patient with an epiphyseal displacement of the lower end of the radius, a young lad who developed signs of incomplete disturbance of the median nerve follow-

ing operative reduction of the displacement with fixation in marked palmar flexion. He supplied us with the following notes.

CASE 5. S. R., a boy 15 years of age, sustained a fracture of the distal end of the radius and styloid process of the ulna. Roentgenograms showed a separation of the radial epiphysis with marked backward displacement, also a fracture of the styloid of the ulna in good position. Four attempts at reduction by manipulation under local anesthesia successfully on July 27, 28, August 6 and 8, 1931 failed to reduce the displacement (Figs. 9 and 10).

Operation, August 10, 1931. Through a dorsal incision reduction was accomplished with ease after a loose fragment of bone had been removed. Immobilization in plaster was carried out with the wrist in a position of marked palmar flexion. Immediately following its application, it was split to insure good circulation.

The postoperative notes were as follows: August 10, circulation good, only moderate discomfort. August 11, fairly comfortable night with occasional numbness in the fingers, but this is not constant. August 12 (3 days after operation) roentgenograms show excellent position (Fig. 11). Patient is having some intermittent pain described as "deep bone pain" with motion of the first, second, and third digits. At this time these symptoms were attributed to injury of the median nerve which had resulted from trauma incurred incident to the frequent manipulations. August 13 sensation improving in the fingers. August 22, wound healed, sutures removed. The patient states that he is beginning to feel a tingling pain in the index and middle fingers. August 31, 3 months after operation, roentgenograms show good reduction with abundant callus formation. New splints applied and the patient discharged from the hospital. At this time the sensation was improving in the fingers and thumb. There never had been any definite motor paralysis. No further notes were obtainable as the patient did not return.

INJURIES TO THE MEDIAN NERVE WHEN THE FRACTURE WAS REDUCED BY MANIPULATION AND IMMOBILIZED IN PALMAR FLEXION AND ULNAR DEVIATION

Realizing that the position of immobilization was the all important factor in production of injury to the median nerve, we began to suspect that certain cases with palmar flexion after reduction by manipulation would show involvement of the nerve. In a comparatively short time we saw 3 additional cases of this type. All were incomplete lesions without any pronounced motor involvement, the principal changes being in the sensory supply of the median nerve. The chief complaint in all was pain and numbness of the thumb, index, and middle fingers. In one of these patients there was a complaint of hyperesthesia in the fingers 6 months after the fracture had occurred.

CASE REPORTS

CASE 6. E. C. aged 44 years, was admitted to the University of California Outpatient Clinic, on May 22, 1932. Four days previously she had sustained a Colles' fracture of the left forearm. At this time the examination and roentgenograms showed posterior deformity of the distal end of the radius (Fig. 12).

On May 22, 1932 manipulation under gas anesthesia with fixation in plaster of Paris splints was done. Roentgenograms showed failure of reduction (Fig. 13). Median nerve was not involved following manipulation.

On May 23, 1932 a second manipulation was carried out under gas anesthesia and the hand was immobilized in marked palmar flexion (Fig. 14). When the patient awakened from the anesthetic, she immediately complained of severe pain and numbness of the hand. In about 30 minutes examination disclosed a decreased sensation in the fingers supplied by the median and ulnar nerves. Therefore, the cast was split along one side and no constriction of the arm was noted. By evening the hyperesthesia cleared over the ulnar nerve distribution, but continued over that of the median nerve. On June 4, 10 days after the second manipulation, the patient still complained of numbness over the median nerve supply to the fingers. The cast was removed and a new one applied with a decreased degree of palmar flexion. On June 11 the splints were removed and motion begun. The posterior plaster was used as a splint. On June 18, the splints were removed and physiotherapy started. On October 19, about 5 months after the injury the patient still complained of numbness on the volar surface of the tip of the ring finger and thumb. Otherwise the sensation had been restored to normal.

CASE 7. Mrs. H. B. T., aged 56 years, was first seen on February 18, 1932 about 6 months after she had sustained a Colles' fracture of the right wrist. The fracture was reduced and immobilized in plaster but recurred, and a second manipulation was done with immobilization in more acute palmar flexion. Following this there was considerable pain and swelling of the fingers. She complained of numbness and severe pain in the thumb, index, and middle fingers. The immobilization was maintained for 4 weeks and was followed by diathermy and massage.

At present, 6 months after injury she complains of limitation of motion of the wrist, weakness, and moderate hyperesthesia of the fingers. She does not seek advice particularly about the hyperesthesia but because of lack of rotary movements of the forearm.

The clinical examination showed that the right wrist was somewhat larger than the left. There was moderate tenderness over the lower end of the radius and over the styloid process of the ulna. Motion of the fingers and wrist was quite free, while supination of the forearm was about one-half limited. When testing for sensory involvement, we found hyperesthesia of moderate degree over the thumb, index, and middle fingers. The patient states that this hyperesthesia has been gradually improving.

CASE 8. Mrs. E. J. (courtesy of Dr. F. J. Sullivan) was struck by an automobile on February 4, 1933, and sustained a Colles' fracture of the right radius (Fig. 15). Physical examination before reduction revealed a deep hematoma, about 4 centimeters in diameter on the flexor aspect of the forearm over the distal end of the radius. The fracture was reduced and held by a plaster cast (split laterally) in extreme palmar flexion and ulnar deviation (Fig. 16). The following morning, 16 hours after reduction, the patient complained of numbness and tingling in the thumb, index, and middle fingers. Examination revealed anesthesia of these fingers including the entire palmar surface of the middle finger. There was some limitation of motion in the thumb, notably on attempting opposition. Four days later the feeling of numbness had disappeared, the movement of the thumb had improved but there was still loss of the sensation of pain. At present 10 days after injury, there is still hyperesthesia over the fingers but motion of the thumb has slightly improved.

CASE 9. We are indebted to Dr. H. H. Hitchcock for the following case. J. M., aged 15 years, on February 4, 1933,

while playing basketball fell on the extended hand and sustained a fracture of the distal end of the left radius with complete dorsal dislocation of the distal epiphysis. He was given an anesthetic about an hour and a half later and the dislocated epiphysis and fracture were reduced. The hand was put up in a position of acute palmar flexion to prevent slipping. X-ray films taken after manipulation showed an accurate reduction. Following fixation in this position a partial anesthesia developed in the thumb and first two fingers. On February 15, the position of acute palmar flexion was changed to one of slightly "cock-up."

On February 20, there is still a marked diminution of sensation over the distribution of the median nerve. At the present time this is not accompanied by any pain and is apparently clearing up.

It is evident from the number of cases of median nerve injury following fractures of the lower end of the radius which we have seen over a comparatively short space of time that such injury is not so rare as previous work would indicate and that the matter warrants more than the passing reference which has been given it in the literature. It has been our observation that those individuals who exhibit a great deal of both initial and subsequent pain following fracture of the lower end of the radius invariably make unsatisfactory progress and show a tardy return to full function which latter they may even fail to attain. Many of these patients exhibit trophic changes in the hand. In the past we have attributed the stiffness, notably that of the thumb and index finger to stiffness of the joints following immobilization. While this assumption may be true in part we feel that in many cases the delay in functional return is directly due to implication of the median nerve, either from what we have classed as a secondary neuritis or from treatment. Minor injuries to this nerve must frequently be overlooked nevertheless injuries to this nerve though minor may play a considerable part in the production of the incapacity which so frequently follows these fractures. When we remember how many of these patients show changes of a degree which can hardly have adequate explanation in the assumption of their being due to disuse it is suggestive that the median nerve carries the major sympathetic nerve supply to the hand to joints as well as to other structures.

In the section on special anatomy we have indicated the intimate relationship which the median nerve bears to the lower border of the radius and to the transverse carpal ligament. We have shown that the interval between the latter structures is strikingly diminished by palmar flexion of the wrist. Excessive swelling or the presence of a hematoma, by further diminishing this interval, will render nerve injury by this mechanism even more effective (Case 8). In late cases, firm

tion of the nerve in scar tissue subsequent to the fracture, by reducing the normal mobility of the nerve prevents its retirement from the oncoming parts.

We are of the opinion, therefore, that acute palmar flexion of the wrist should be used with great caution and in no case with marked swelling. In late cases when osteotomy is used for the correction of deformity we advise against the use of acute palmar flexion unless the surgeon employs frequent observations to detect signs of pressure on the median nerve and is prepared to relieve such pressure by immediate change of this position.

We believe it important to emphasize here that the position of palmar flexion should be used only after complete reduction of the fracture has been secured. Yet, we have observed that this position is frequently employed in the hope that it will overcome and correct the displacement an idea which grossly misinterprets the purpose for which this position was originally intended.

The objection may be raised that involvement of the nerve had occurred in our cases prior to the use of palmar flexion as a means of fixation. After our first experience as recorded in Case 3, we have constantly borne in mind the possibility of this complication and have made it a point for special examination before further treatment was instituted.

Considerations of the data discussed seem to emphasize the necessity of carrying out a thorough examination to determine the presence or absence of a median nerve injury with a view to prognosis and treatment. If a position of marked palmar flexion is to be used for fixation then frequent examinations should be carried out to ascertain whether there are signs of injury to this nerve. Such injury may become the major complicating factor as we have learned to our cost.

CONCLUSIONS

1. Injuries to the median nerve in fractures of the lower end of the radius may be primary, secondary or delayed.

2. In the primary lesion the injury to the nerve is due to the initial trauma and is comparatively rare in the secondary and delayed groups, to

pressure and friction of the nerve against projecting fragments in mal-united fractures.

3. We are of the opinion that there is a fourth even more frequent cause of injury to this nerve caused by acute palmar flexion of the wrist.

4. We have found these injuries in operative reduction of old mal-united fractures and those in which the displacement is reduced by manipulation, in all associated with acute palmar flexion.

5. From anatomical dissections and injections of the sheath of the median nerve, we have shown that the injury is produced by pressure of the nerve between the transverse carpal ligament and the anterior border of the lower end of the radius.

6. The majority of the cases we believe to be incomplete and transient in character but some are of sufficient severity to require a neurolysis. We would judge that the severity of the lesion is in direct proportion to the degree of palmar flexion.

7. In all cases of fractures of the lower end of the radius, the surgeon should determine the presence or absence of median nerve involvement before reduction is attempted. If palmar flexion is chosen as a position for fixation frequent examinations of the sensory and motor supply of the thumb and fingers should be made to avoid a possible injury to the median nerve which, in the severe cases, may lead to a degree of permanent loss of function of the hand.

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RUPTURE OF THE SYMPHYSIS PUBIS ARTICULATION DURING DELIVERY¹

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RUPTURE of the symphysis pubis during delivery associated with clinical symptoms, although rare, occurs more frequently than is generally believed. The lack of recognition of this lesion is a factor in its rarity. Seven cases that occurred on the Gynecological and Obstetrical Service of the Boston City Hospital and have been recently reported by the author were subjected to various types of treatment as a means of correction. To this group are added 9 more cases of ruptured symphysis pubis occurring during delivery the treatment of which has been carried out under a new method which has proved more beneficial to the patient and which has also required a shorter hospital convalescence. This method has also been utilized by the surgical services of the Boston City Hospital in the treatment of 8 cases involving fractured pelvis and fractured ramus, with equally efficient end results.

In this series there were 2 primiparae and 14 multiparae. One primipara rupture was due to a spontaneous delivery and the second followed forceps delivery. Of the multiparae 2 were in the second pregnancy, 6 in the third, 4 in the fourth, and 2 in their fifth pregnancy. One patient, who had had two previous high forceps deliveries because of high blood pressure and bagging, had a cesarean section performed due to the failure of the head to engage. This patient had been re-delivered and re-ruptured 1 inch more in her fourth delivery. At her last examination, following a 6 months' miscarriage, she had a normal symphyseal union without separation or symptoms. Ten of these cases occurred in normal deliveries, 1 followed a breech, 2 were mid forceps delivery and 3 cases were due to falls on the sidewalk prior to deliveries. Twelve of these cases occurred in 6263 deliveries from January 1931, to April 1933 inclusive on the Obstetrical Service of the Boston City Hospital. The ratio of occurrence was 1 in 521 deliveries of all types.

ETIOLOGY

Many hypotheses have been advocated as an explanation for the separation of the symphysis pubis. The etiological factors fall within six groups: (1) excess of a normal physiological proc-

ess (2) trauma (3) posture causing joint weakness or displacement (4) subluxation of the bones due to ligamentous relaxation (5) general lack of physical tone (6) diseases such as tuberculosis and hypertrophic arthritis. The increased blood and lymph supply accompanying pregnancy produces definite changes in the ligaments of the symphysis pubis as well as in those of the sacroiliac synchondroses. Increased mobility of the pelvic girdle joints is also produced. Le Gallois in 1812, Knox in 1839 and Barlow in 1854 reported these alterations of the symphysis pubis in parturient guinea pigs, seals, and cows, respectively. Keller attributes the separation in spontaneous labor to marked intensity of uterine contractions, plus marked rapidity of labor. Duncan in 1867 portrayed the behavior of the pelvic joints in pregnancy and labor by establishing the mobility of the pelvis, since the sacrum normally rotates within small limits on a transverse diameter. This change of the sacrum is produced in both sexes. Cantin made a study of 500 cases of relaxation of the joints during pregnancy as distinguished from rupture of the articulations during labor. He concluded that (1) relaxation of the pelvic articulation is associated with pregnancy, being most marked in the symphysis. Changes are less marked in the sacroiliac synchondroses, but do exist. All but 2 per cent of the cases showed mobility. Sixteen per cent showed 1 millimeter relaxation, while in all others the relaxation did not exceed 3 millimeters. (2) Absolute rigidity of the joints existed in 2 per cent of the cases. (3) Relaxation occurred more frequently and to a greater degree in multiparae than primiparae. (4) There is no relation between the degree of relaxation and severity of symptoms which range from slight localized to referred generalized pain. (5) Pregnancy gradually increases the condition. Following delivery the condition returns to normal in a few weeks but may persist for months or years and disable the patient to a greater or less degree. During the mechanism of labor the tilting of the sacrum or mobility of the pelvic articulations is of definite importance. The enlargement of the anteroposterior diameter at the pelvic brim by drawing the sacrum backward has been demonstrated by Walcher for

whom this position is named. His measurements showed that the anteroposterior diameter at the brim was greatest with the legs hanging free and narrowest with the legs flexed upon the abdomen. The diameters of the inlet and outlet can be controlled and modified within a certain range and muscular force for expulsion can be preserved. If the displacement of the sacrum is not allowed to develop real pelvic instability.

ANATOMY

The symphysis pubis results when the anterior wall of the osseous pelvis is completed by the articulation of the bodies of the two pubic bones. It is held together by four ligaments, the anterior pubic (the strongest), the posterior pubic (the weakest), the superior and inferior pubic (arcuate). Each pubic bone is covered with a layer of hyaline cartilage. Between these hyaline layers is an interposed fibrocartilage called the lamina fibrocartilaginea interpubica, in the interior of which there is a vertical anteroposterior cleft. This cavity appears between the seventh and tenth years and is attributed to the breaking down of the interpubic lamina.

HISTOLOGICAL CHANGES

Putschar reported no principal difference in the cleft formation of the multiparic nulliparic or males in a histological study of 60 cases. Loeschcke demonstrated that the median cleft of the symphysis is often present during early life but may be absent in males throughout life. Various zones of degeneration and vascularization appear in the hyaline cartilaginous plate which covers the bony ends, during the growth period. The disc, which is at first solid, shows, in a later period, elevations, tears, and fatty degeneration. The hyaline cartilage decreases with age and may be replaced with fibrous cartilage. Loeschcke states that hypertrophy of the symphyseal ligaments, loosening of the symphyseal disc, the increased growth of bone in young women and the renewed growth of cartilaginous margin in older women are the resultant severe changes produced in the symphysis by pregnancy and parturition. Termination of physiological growth of the symphysis is indefinite. Quantitative estimation of the cartilaginous growth is difficult since it is meager at 21 years and may be well pronounced at the age of 25. Cartilaginous growth is not demonstrable beyond the twenty-fifth year except for a slight proliferation of the posterior bony margins of the pubic bone. Ossification of the deeper layers of hyaline cartilage, which is not preceded by cartilaginous prolifera-

tion is found in the pregnant, the non-pregnant, and men at this period. No enlargement of the pelvis is produced by this ossification. The degree of bony growth is calculated by the extent of forward protrusion of the ligamentous insertion which bridges the posterior surface of the symphysis. New connective tissue forms between the periosteum and bone and serves to strengthen the ligament.

PATHOLOGY

Infection, hemorrhage and laceration of the ligaments may be produced by this injury. The pubic ligaments are torn and the fibrocartilaginous union of the symphysis is severed. Complete separation of the joint may occur but is rare. With infection present abscess formation results due to lacerations extending into the vagina. Two abscesses occurred in this series, one being vaginal and the second suprapubic in character. Edema of this area is generally due to hemorrhage as the result of tearing of the ligamentous fibers.

MECHANICS

The forceful descent of the fetal head through the superior strait and against the pelvic ring produces the separation of the symphysis. Sacro-iliac involvement on one or both sides and a posterior displacement of the acetabulum may often accompany this lesion. Poulett, and later Fowler demonstrated experimentally that about 170 or more kilograms of direct pull were required to separate the symphysis. Reis et al, quoting Schatz, state that the combined contractile power of uterine and voluntary musculature is 50 kilograms or one-quarter of the force necessary as in a direct pull. This latter is probably the factor in spontaneous delivery. Sacro-iliac involvement occurred in 10 cases, being more pronounced on the left than right. Both joints were involved in 3 cases. Four cases showed no involvement.

ROENTGEN STUDIES

The evaluation of the X ray as a diagnostic aid proved fruitless except in those cases in which there was a gross separation present. In all cases in this series diagnosis was made clinically on the symptoms, as separations, and was checked by X ray examination as a means of noting the sacro-iliac involvement. In a separate series of normal cases following normal, forceps, and cesarean deliveries, studied in conjunction with Dr. Paul Tivnan, although showing no increased widening of the joint following delivery they did show motility of this joint, which persisted for 6 to 8 weeks. Fluoroscopic examination in applying this new method proved beneficial as the rupture

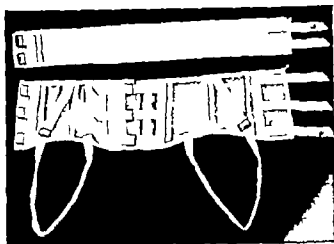


Fig. 1. Both belts are shown individually. The upper belt is the symphyseal belt.

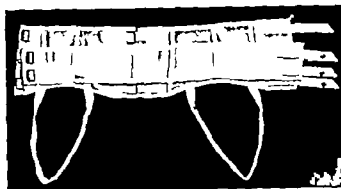


Fig. 2. Both belts in position ready for application.

could be readjusted with ease and accuracy. Flat plates were taken immediately after the application of the belt to be described and checked every 2 months in the absence of symptoms, until the belt was discarded.

CLINICAL SYMPTOMS AND DIAGNOSIS

Clinical signs of separation of the symphysis in this series occurred anywhere from 2 months before to 12 days following delivery. Pain in the symphysis region and also in the lower back, which in some cases radiated down the thigh and legs, appeared constant. Palpation of the symphysis will permit the insertion of one or two fingers between the pubic bones, if edema and tenderness are not too marked. Vaginal examination with the index and middle fingers in the vagina and the thumb over the symphysis, may also show the width of the separation. It is impossible for the patient to get up or lie down. Stooping is performed guardedly and is often impossible unless the knees are flexed and spasm of the hamstrings released. Marked external deviation is present if one side is affected more than the other. Lateral deviation is common. Forward bending with the knees straight is limited as the hamstring muscles attached at the tuberosity of the ischium are made tense and by causing strain upon the sacro-iliac articulations develop muscular spasm. Lateral bending varies according to the side affected but is more guarded on the worse side. Adduction with the thighs flexed develops pain and straight leg raising is limited. Spasm of the hamstrings gives rise to a peculiar gait. In taking the first step the knee can be drawn up without difficulty but as the leg straightens the spasm develops and the foot is drawn up or almost jerked backward so that in the extreme case the foot

may strike the floor a little in advance of its position when the step began.

Motility of this condition can be easily demonstrated. Forced hyperextension of the thighs one at a time, thus moving the ilia away from the sacrum, may be sufficient. With the patient standing one hand is held over the sacrum while the pubic bones are held between the thumb and finger of the other hand. When the patient raises one knee and then the other, the motion is often distinct. Grasping the crest of the ilia with the two hands the thumbs resting upon the sacrum and the patient raising the legs as above, motility is often apparent. With the patient lying down straight, leg raising produces motion and pain at the symphysis.

Differential demonstration of disease of these joints can be determined by the atrophy of the muscle adjacent to or below the joint, attitude in standing or walking, by limitation in motion and by local tenderness or swelling. The character of the disease is generally determined by the appearance of the patient, and locally by the absence or presence of abscess or tumor formation.

TREATMENT

Removal of the tension and strain from the sacro-iliac joints which in turn cures the symphyseal condition affords the patient considerable relief from pain. Insertion of a fracture board between the bed springs and mattress will readily relieve the usual sagging of the bed. Adhesive strapping canvas slings enveloping the pelvis, and butterfly braces have been applied in the earlier cases and although effective, required long hospital convalescence and a constant follow up to maintain correction of the disability. Strapping the sacro-iliac joints first and correcting this phase and then encircling the pelvis with a piece of adhesive plaster 6 inches wide afforded the best results in the methods mentioned. The difficulty encountered with adhesive was that the plaster



Fig. 3. Case to which this belt was applied. The patient exhibited all the characteristic symptoms on the tenth day after delivery. X ray plates shows symphyseal separation with left sacro-iliac involvement.

rolled, softened and became loose after a week's body perspiration and then failed to produce an effective support. Retention of the adhesive too long also produced pustules of the skin and in one of the cases was a factor in producing a supra-pubic abscess. For the reasons mentioned it was deemed advisable to try a belt made of saten and involving the same principles. Under the supervision of Mr. Peter F. Rogerson, in charge of the Orthopedic shop of the Boston City Hospital, the belts are made to order and to fit the individual. Mr. Rogerson has named the belt the Boland belt. Its efficiency has been so great in the



Fig. 4. X ray plate taken after the belt was applied and the condition corrected. The belt was applied and position obtained under the fluoroscope.

symphysis cases that orthopedic surgeons have since used it with excellent results in other injuries to the pelvis.

DESCRIPTION OF THE BELT

The belt is made of four ply saten with the under belt 7 inches wide. The under belt portion has whale bone stays and straps that buckle in the front and back. The top belt which gives direct pressure over the symphysis is 4 inches wide and buckles in front. Felt and horse hide pads cover the edges of the belt over the trochanter region to relieve pressure. Perineal straps which are covered with rubber tubing and which buckle in front hold the belt down in position.

APPLICATION OF THE BELT

Patients who present clinical symptoms are first roentgenographed and examined by the orthopedic service, in consultation. Measurements are taken for the belt and a temporary swathe is bound around the pelvis to give support and relieve tension. A fracture board is inserted between the bed springs and mattress. When the belt is completed the patient is removed to the fluoroscopic room in the X ray department and the belt is applied. By tightening up on the under belt the sacro-iliacs are returned to normal position. The upper belt is then applied and the symphysis pubis is restored to normal position. During these movements the correction of the deformity can be observed accurately. A flat X ray plate is then taken for permanent record. The above maneuvers close the sacro-iliac joints,



Fig. 5. End-result of Figures 3 and 4 when the patient was discharged.



Fig. 6 Front view of the belt on the patient up and about the ward.



Fig. 7 (Rear view of the belt on the same patient prior to discharge.

restore the acetabula to a normal plane, and also close the gap at the symphysis. In the first few cases in which the belt was used severe pain was encountered when the symphysis or upper belt was tightened so as to remove the gap in this region. Further observations showed that, if the sacro-iliac separation is corrected under the fluoroscope and the upper belt is applied and tightened as much as the patient can stand without discomfort, with the release of muscle spasm after about 48 hours, the symphysis belt can then be approximated without discomfort to the patient. The gap if a 2 or 3 inch rupture is then restored to normal position. The fracture board is removed as the belt supports the patient and holds the parts firmly. Crutches were used in the earlier series of cases before the belt was used when patients were allowed out of bed. Crutches are now discarded as, with the belt applied the patient has ample support and can walk, her bowels will move and she can bend. Patient must be free from tenderness and symptoms such as positive straight leg raising and flexion before being allowed out of bed. Many of these patients if observed immediately following delivery are able to be out of bed on the sixteenth day. In

this last series of cases 6 were discharged in 3 weeks, 3 others in 4 weeks, as compared to an 8 to 10 weeks convalescence under the prior treatment.

DELIVERY

Obstetricians differ as to the method of delivery when this condition is present. The writer prefers to permit nature to take its course unless there is danger to the mother or baby when delivery is then terminated by forceps. Others advocate immediate delivery by forceps or version extraction. Correction of posterior or brow positions aid the mechanism of labor.

DISCUSSION OF CASES

One patient, who sustained a separation of the symphysis suffered a re separation in her second delivery but at this time restoration to normal position was more readily secured than in the first instance. Another patient, whose symptoms appeared at the seventh month, showed an elevation on the left side of the symphysis, due to a marked sacro-iliac condition also on this side. A Thomas splint with traction of 5 pounds was applied to the left leg. The belt readily relieved the sacro-iliac condition. The patient was dis-

charged after 4 weeks, free from symptoms. She returned and had a normal delivery but separation of the symphysis was at least one-half inch more than at her first entrance. No sacro-iliac signs were present after delivery but with the belt applied tightly following delivery the symphysis was readily restored to normal.

Two patients had abscesses of the vulva. Morphine failed to control the labor pains in those cases in which separation occurred before delivery.

CONCLUSIONS

1. Spontaneous delivery can produce a separation of the symphysis pubis.
2. The condition occurs more frequently in the multiparous patient.
3. Pain and tenderness in the region of the pubic and sacro-iliac joints, palpable separation at the symphysis, positive straight leg raising and peculiar gait are the most common symptoms.
4. Roentgenograms show the sacro-iliac involvement and confirm the symphysis separation.
5. Treatment consists in the use of a fracture board or Bradford frame together with a tight swathe to relieve the acuteness of the lesion.
6. Application of the double belt, herein described closes the sacro-iliac separation, restores the acetabula to a normal plane, and removes the gap at the symphysis pubis.
7. Re-separation of the symphysis occurred in succeeding deliveries.
8. Correction of the symphyseal and sacro-iliac separation are essential for functional results.
9. The double belt permits a shorter hospital convalescence and restores earlier function than other methods.

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RE-ESTABLISHMENT OF NORMAL LEVERAGE OF THE PATELLA IN KNEE FLEXION DEFORMITY IN SPASTIC PARALYSIS

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FLEXION deformity of the knee in spastic paralysis presents a problem not to be solved by any one surgical measure. Preservation of calf action in counteracting flexion of the knee is well recognized. In spastic paralysis, this action corresponds to the stabilization, by calf action of flaccid paralysis involving the quadriceps. Manipulative correction of flexion deformity of the knee in spastic conditions is seldom successful. Division and lengthening of the hamstring muscles or division of the motor nerve supply of these groups is frequently sufficient to permit standing with the knees in full extension. At times transplantation of the biceps to the anterior aspect of the thigh to act as an extensor, aids in maintaining extension.

In a limited group of spastic cases none of these procedures is successful and weight bearing with the knees completely extended is impossible. Such patients stand and walk with the knee in partial flexion (Fig. 9). Active extension to about 160 degrees is possible and in some complete passive extension is possible, especially if the hamstring strings have been lengthened. In these cases the position of the patella should be determined.

The normal patella is in a position anterior and distal to the epiphyseal line at the lower end of the femur (Fig. 8A). On flexion, the patella fits into the intercondylar groove and diminishes in prominence as flexion becomes more pronounced (Fig. 10B). If the spastic patients who stand with knees partially flexed are examined to ascertain the position of the patellæ some will be found to depart widely from the normal. The patella will be found opposite the lower shaft of the femur and proximal to the articulating surfaces of the condyles. On flexion, these patellæ become prominent riding high on the condyles of the femur giving the knee an angular appearance (Figs. 5 6A 7A 10A 10C). The patellæ do not sink into the intercondylar notch. The patellar tendon appears unusually long and is prominent anteriorly. Active extension is limited even when the posterior muscles have been lengthened. With the patella in this position quadriceps action is lost through out the last few degrees of extension because of the loss of leverage normally transmitted through it.

The elongation of the patellar tendon and the secondary high position of the patella may be con-

sidered adaptive changes resulting from prolonged tension during the period of rapid growth. In complete extension of the normal knee while weight bearing the quadriceps muscle is relaxed. Contraction begins, however within the first few degrees of flexion and continues as long as weight is carried through the knee joint. In some spastics the knee is never completely extended consequently there is no period of muscular relaxation while weight bearing. This continued tension added to the spastic tonicity of the muscle may readily result in elongation of the patellar tendon.

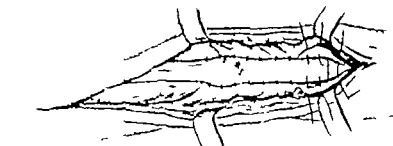
After many unsuccessful attempts to correct this type of flexion deformity by stretching of the knee, releasing of the posterior musculature, and by transplanting the hamstring muscles the following operation to restore the normal leverage of the patella was developed.

TECHNIQUE OF OPERATION

A vertical lateral patellar incision angulating medially across the center of the patellar ligament and extending distally along the anteromedial aspect of the tibia is made through the skin and subcutaneous tissues. Parallel incisions along the medial and lateral margins of the patellar tendon expose its entire length. The tendon separates from the anterior fat pad very readily and its insertion into the tubercle of the tibia is exposed. Then a block of bone at the insertion of the tendon is removed. A second block of tibial cortex, distal to the first and separated from it by an in-



Fig. 1. Photograph of knee with elongation of patellar tendon. Note angular contour and high patella.



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Fig. 5.

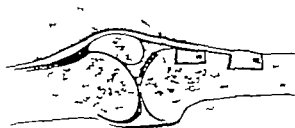


Fig. 4.

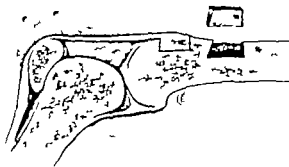


Fig. 3.

Fig. 2. Incision. Patellar tendon is freed by incision through fascia and peritendon as indicated by heavy dotted lines.

Fig. 3. Sagittal section through knee before advancement of insertion of patellar tendon. *a* is then transposed to distal recess in tibial surface.

Fig. 4. Sagittal section of knee after advancement of patellar tendon. Bone fragment *b* filling defect left by removing *a*.

Fig. 5. Closure. Peritendon matted over transplanted insertion of patellar tendon. The aponeuroses are then sutured to the tendon and patella.

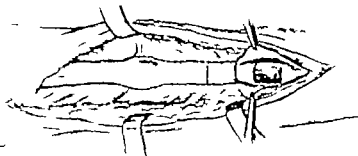


Fig. 2.



Fig 6 A, Case of severe spastic paraplegia showing elongated patellar tendon with high position of patella. B Lateral roentgenogram of knee following advancement operation.

tact ridge of cortex is removed (Figs. 2 and 3). The patella is mobilized by division of the aponeuroses of the vastus medialis and vastus lateralis and the tibial tubercle is countersunk into the second recess in the tibia thus moving the point of the insertion of the patellar tendon distally about one

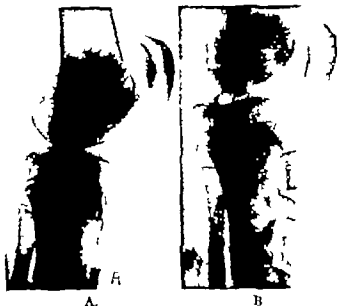


Fig 7 Before and after advancement of patellar tendon.

and one-quarter inches. The distal block may be replaced in the cavity remaining after the removal of the tubercle. The tendon and insertion then are fixed in their new position (Figs. 4, 5, 6 and 7).

This advance of the patellar tendon may be accomplished without opening the knee joint. The preliminary division or lengthening of short hamstring muscles is essential.

The leg is kept fully extended in a plaster splint for 8 weeks. Active and passive movements are then begun.



Fig 8. A, Lateral roentgenogram of normal knee flexed 90 degrees. Note position of patella in relation to condyles. B Lateral roentgenogram of left knee before advancement operation was performed. C Lateral roentgenogram showing appearance of left knee after advancement operation was performed.



Fig. 9. Patient E. P. Showing adduction of thighs, flexed position of knees, and high patella.

By bringing the patella down to a normal position the leverage of the quadriceps femoris is re-established and full extension of the knee made possible.



Fig. 10. A, Lateral view of right knee in flexion. Note angular contour of knee caused by high position of patella on condyle. B, Lateral view of normal knee showing de-

CASE REPORT

E. P., female, aged 9 years, admitted to Children's Memorial Hospital, February 23, 1932. The patient complained chiefly of inability to use arms or legs, inability to talk, total inability to walk. Patient was a full term baby with shoulder presentation. This was converted to a cephalic presentation and delivery was accomplished by instruments. At time of delivery the head was badly distorted and there was some laceration of the scalp. Deep cyanosis was present and resuscitation very difficult. Twenty four hours after birth there were two severe convulsions but none since that time. The child did not cry until about 6 months of age. She has been unable to sit up on a table or in bed, but can sit up in a chair. She has never walked. The head was held in a flexed position until she was about 5 years of age when she began to extend it actively. She made attempts to talk when 6 years old, but could not say words which could be understood. At about 3 years of age, she showed the first signs of being interested in toys. Besides the general spastic condition of all muscles, she has had no serious illness with the exception of bronchopneumonia during infancy.

The father and mother are alive and well. There is the history of one other child who died at birth following a forceps delivery.

Admission laboratory findings: red blood cells, 4,300,000; hemoglobin, 76 per cent; white blood cells, 9,900; polymorphonuclears, 44 per cent, lymphocytes, 56 per cent, urinalysis, negative; von Pirquet, negative; Wassermann, negative.

Examination revealed a poorly developed, poorly nourished white girl of about 9 years of age, not acutely ill. The patient was unable to sit up or talk. There was a very evident spasticity of marked degree involving all extremities, facial and trunk muscles. The eyes were normal except for some spasticity of motion and some dilation of the left pupil. Both reacted normally to light. The heart, lungs, and abdomen were essentially normal. The upper extremities showed a very marked spasticity with the arms held partially flexed at the elbow, and the forearms were somewhat pronated. Irregular jerky movements were present in both arms, the patient making desperate attempts to cooperate in producing a purposeful movement. The head was held partially flexed and, on attempting to look up, had an irregular rolling motion to both the right and left sides. Patient was unable to sit except when bolstered up in an arm chair. She was totally unable to stand. When assisted to a standing position, both legs crossed in an extreme scissora position. The knees were flexed 25 to 30 degrees, and the feet were in marked equinus. All reflexes were hyperactive. There was a bilateral Babinski.

pression of patella into intercondylar groove, on flexion. C, Position of patella when active extension is achieved. The patellar tendon is elongated.

Operation was done on March 12, 1931. The hamstring muscle groups of both knees were divided and extension casts were applied. This resulted in complete correction of the flexion deformity. On March 25, 1931, lengthening of both Achilles tendons was done. The patient was given general exercises directed at the development of better co-ordination and was given speech training. Very satisfactory correction of flexion deformity of the knees and equinus position of the feet was obtained. The patient was able to walk between parallel bars but was unable to stand without assistance. Under weight bearing, the knees flexed to a position of about 25 degrees. The tendency to a scissors gait persisted. The patient was discharged home and at a later date was admitted to the Spaulding School into a class for spastic children.

In August, 1932, the patient was re-admitted for further surgery. During this time, there had been a very definite improvement in speech and general co-ordination of the upper as well as the lower extremities. The scissors gait was very pronounced. This was corrected on August 16, 1932, by a bilateral suprapubic extraperitoneal resection of the obturator nerves. Immediate and complete relaxation of the abductor spasm was secured. Sufficient active adduction persisted to enable the patient to bring knees together voluntarily. Although passively both knees could be extended completely when weight bearing or in attempts at voluntary extension 25 to 30 degrees flexion persisted. At this time it was noted that both patellae rode very high on

the condyles, giving both knees an angular appearance. It was obvious that both patellar tendons were markedly elongated and that all the leverage through the patella was lost during the last 25 degrees of extension.

On September 15, 1932, an advancement operation was done, the insertion of the patellar tendon on the left being advanced one and one-quarter inches. Casts were applied, holding complete extension for 8 weeks. This was followed by active and passive movement to restore motion at the knee joint. Under weight bearing and active contraction of the quadriceps muscle, complete extension was possible. On January 17, 1933, a similar operation was repeated, advancing the insertion of the patellar tendon on the right, one and one-quarter inches. This was followed by retention in plaster in a fully extended position.

CONCLUSION

Elongation of the patellar tendon with loss of patellar leverage is encountered in spastic paralysis.

The re-establishment of the normal leverage of the patella permits complete voluntary extension of the knee joint.

Waltham, in 1803, employed this principle in the treatment of lateral dislocation of the patella.

TREATMENT OF FRACTURES OF THE HEAD AND NECK OF THE RADIUS AND SLIPPED RADIAL EPIPHYSIS IN CHILDREN¹

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WE have recorded 64 references from the literature 34 of which have been reviewed to form a basis for our conclusions. These indicate that the subject of this paper is no longer to be regarded as a rare traumatic affection.

Our purpose, therefore is to summarize the present status of treatment of fractures of the head and neck of the radius. Special attention is directed toward the question of immediate operation for correction of deformity in cases presenting displacement of the radial epiphysis and malalignment in fractures of the radial neck. Three cases are reported to illustrate these two types of fractures.

The mechanism of injury is usually characterized by a fully extended and pronated forearm which receives the body weight in protecting the patient from a fall. A blow received over the radial head and neck may produce such an injury.

The following classification forms the basis for the subsequent consideration of the various forms of treatment.

A. Fractures within the radiohumeral joint—1. Fractures of the radial head. 2. Displacement of the radial epiphysis. 3. Linear fractures from the radial head into the radial neck.

B. Fractures outside of the radio-humeral joint—1. Fractures primarily affecting the radial neck between the level of the synovial membrane attachment and the insertion of the biceps tendon.

C. It is understood that varying degrees of comminution, impaction and malalignment may prevail in either the A or B group. Moreover group B is frequently complicated by conditions prevailing in group A. Such fractures may be complicated by varying degrees of injury to the humerus, particularly fracture of the external condyle. The presence or absence of injury to the radius should be sought in all cases of elbow dislocation.

The clinical picture. The forearm is usually supported by the opposite hand, in a position of approximately 90 degrees flexion at the elbow. Muscle spasm holds it in a position midway between pronation and supination.

There is the usual evidence of periarticular tissue reaction to trauma. The maximum swelling with varying degrees of ecchymosis is usually centered over the radial head. The external evidence of injury in the absence of deformity is usually not great enough to explain the disability present. Gentle passive extension and flexion of the elbow may be 50 per cent of normal with relatively little evidence of pain. Although this is a variable finding great pain accompanies any passive effort to change the degree of pronation or supination from the fixed position. Radial deviation of the forearm causes greater pain more quickly than when a similar passive effort is made to produce ulnar deviation. Palpation gives evidence of tension due to underlying hemorrhage. The application of the index finger may define a point of maximum tenderness over the radial head and neck. All three of the patients reported herewith complained of referred pain to the radial side of the wrist when pressure was applied over the radial head and neck by the index finger. This clinical observation has not been recorded in any of the references reviewed by the authors. Crepitus is frequently absent regardless of methods employed to elicit it more-over this physical sign is not essential to the clinical diagnosis. As a general rule, altered alignment of the fragments may be neither seen nor felt.

Röntgenographic examination. The radial epiphysis does not ossify until the fifth to the seventh year and unites at the age of 18 to 20 years. Anteroposterior and lateromedial views should be made with the normal forearm held in the same degree of flexion and supination as the affected side. Rarely chip and linear fractures of the radial head may not be revealed. Gross evidence of intra-articular and extra-articular injury of the radius prevails in most genograms of all other fractures included in both A and B groups.

Historical background since the time of Hippocrates. Without the intention of being all-inclusive, the following opinions of 34 authors have been expressed by quotations from respective papers for the obvious advantage of the reader in judging our conclusions.

We were unsuccessful in finding reference to these fractures in the works of Hippocrates (460-370 B.C.) Paul of Aegina (625-690 A.D.) may have known of this injury to the radius. 'The ulna and radius are sometimes both fractured together and sometimes one of them only either in the middle or at one end, as at the elbow or wrist. His brief subsequent discussion does not include further reference to the radial head and neck.

Petit (1726) described a method of eliciting crepitus

It is essential to hold the upper Part of the Fore Arm with one Hand, whilst with the other one makes the Hand of the Patient alternatively perform the Motion of Supination and Pronation, and if at that Time the Radius is found to resist the Hand that holds the upper Part, and makes an Effort against it to move in Pronation or Supination one may be assured that there is no Fracture. On the contrary if the Bone is broken it will not resist and a Crepitation will be heard, because the under Part of the Radius which is moving will rub against the upper Part which is kept, as it were, by the Hand that held the upper Part of the Fore Arm.

This and the remainder of his discourse fails to indicate that Petit recognized fractures of the head and neck of the radius.

Nearly one hundred years later (1811) found Desault writing as follows.

In whatever way the fracture may be produced, it occurs in the middle or at the extremities of the bone very rare near its articulation with the os humeri, it is more common in the middle but more frequent still at its lower end.—If the fracture exists at the upper end, the thick muscular covering which there surrounds the radius, renders the diagnosis more difficult.

He then referred to Petit without giving further information on this subject.

In 1830 S. D. Gross, of Philadelphia, cited Petit; he almost repeated but did not mention Desault and contributed nothing original.

In fractures of the superior extremity of the radius, the symptoms are generally more faintly developed, on account of the great number of muscles in which the bone is imbedded and the diagnosis is consequently more difficult.

James Syme (1832) made no mention of the possibility of injury following direct or indirect trauma to the radial head and neck.

The first definitely recorded observation of fracture of the radial head followed an accidental postmortem finding by Berard, in 1834.

Mais ce signe n'est point aussi infallible que le pense M. Dupuytren. J'ai vu cette année (1834) à l'hôpital Saint Antoine, le bras d'un individu qui s'était tué en se jetant d'un second étage sur le pavé le coude gauche était le siège d'une déformation en tout semblable à celle que l'on observe dans la luxation. La réduction fut ten-

tée et opérée sans trop de difficultés, quoiqu'il y eût de la rigidité cadavérique une pression modérée, exercée sur l'avant bras et le bras en sens contraire, suffit pour opérer un nouveau déplacement, qui s'accompagna d'une légère crépitation. Ces manœuvres de réduction et de luxation furent accomplies plusieurs fois de suite avec le même résultat. Les caractères assignés par M. Dupuytren à la fracture transverse de l'humérus étaient donc ici ou ne peut plus évidents. Or voilà ce que la dissection a montré: 1. luxation de l'avant-bras en arrière; 2. fracture d'une partie de l'apophyse coronoïde du cubitus; 3. fracture d'une portion du radius, qui divisait la cavité articulaire de cet os de dedans en dehors, et aboutissait à un demi-pouce de son extrémité supérieure sur la face antérieure d'où résultait un fragment triangulaire qui par son déplacement facile, enlevait à la cavité articulaire du radius un tiers à peu près de sa surface.

This was not a simple fracture of the radial head a fact not emphasized by previous references to Berard's report.

Ten years later (1844) Sir Astley Cooper said that fractures of the neck of the radius were mentioned by surgeons as being of frequent occurrence but there must be some mistake in the statement for it is an accident which I have never seen and if instances ever present themselves (which I do not deny) they must be very rare.

Helfferich (1897) gave the first unquestionable evidence of recognition and treatment of fractures of the head and neck of the radius together with epiphyseal displacement.

Fracture of the head.—This is wholly intra-articular it may be complete or incomplete (fissure or bending). In the latter case the diagnosis is naturally difficult and uncertain. Cases of complete fracture are to be recognized when the head of the radius is abnormally movable with crepitus, but it may be noted that in such cases the movement of the head in pronation and supination seems to be unaffected. Pain is naturally localized to the region of the radial head. This fracture may be due sometimes to direct more frequently to indirect, violence and the elbow may be either extended or flexed at the time. There are naturally present the signs of injury to the joint and not infrequently this fracture is overlooked, and considered to be only a contusion or a distortion of the elbow. Occasionally the radial nerve is damaged at the same time. Since one can make no direct pressure on the small upper fragment, union will probably take place, in spite of all precautions, with considerable deformity and limitation of movement, which may later justify operation and resection of the radial head. Fractures of the neck of the radius and traumatic separation of the upper epiphysis are both extremely rare as also are fractures of the radial shaft alone.

He gives two illustrations of fracture of the radial head united by bone. The specimen was resected from a woman aged 28 years, who had fallen on the outstretched hand. The joint was stiff at an obtuse angle and pronation was limited.

In 1900 Mouchet reported 11 cases of fracture of the radial neck in children.

The prognosis is good in these cases if the fracture has been properly treated at the beginning. As soon as a diagnosis is made it is necessary to massage and mobilize the fracture daily without paying any attention to reduction which is often impossible to maintain. A proper reduction of the fractures cannot be made by any form of dressing and any apparatus is dangerous for a proper function of the joint.

If a vicious consolidation results in spite of proper treatment and there is a disturbance in the function of the forearm, the surgeon should not hesitate to operate and perform an osteotomy of the neck of the radius. The only inconvenience that may result from this operation consists in the appearance of a slight degree of cubitus valgus at the end of a certain time.

T. Turner Thomas (33) published an article entitled *Experimental Study and Report of Cases on Fractures of the Head of the Radius* in 1905. In the 45 patients reported, there were 48 fractures and only 1 of the patients was 13 years old, none below this age. Therefore the subject of this paper was given relatively little consideration in the classical presentation of this subject by Thomas. He stated:

Instead of being an exceedingly rare fracture as hitherto believed, it is a common one, its peculiarly obscure nature having rendered it especially difficult of recognition. There are more cases of this fracture, represented by skiagraphs in the hands of a few skiagraphers in Philadelphia (53) than the writers could find after a thorough search of the literature (45) making a total of 93. When only the radial head is fractured, primary excision of the head should not be done. Excision of the head under any circumstances, even excision of the detached fragment, will rarely be required.

Union of the fragments will occur in many cases, even if moderate movements of the elbow be encouraged during the healing process. The possibility of non-union, however, will always be present, and as it will be difficult to determine the exact condition prevailing within the joint, it will probably be best in all cases to permit no movement for the first three or four weeks. Movements during this period probably do little good and may do much harm.

In 1907 Thomas (34) published another paper on "Fractures of the Head and Neck of the Radius" in which he discussed the problem of diagnosis; treatment was excluded.

In 1909 Hammond reported that he had seen 14 cases of fracture of the head of the radius in a total of 344 cases of all fractures. Relative to treatment he states:

In cases with good approximation of fragments and but slight displacement, I have had the best results with the right-angled tin splint, fashioned for the individual arm and supported by a sling. The splint should be left in place for several days to a week. It is then removed at intervals of two to three days and massage and gentle passive movements begun. At the end of three to four weeks all apparatus may usually be omitted.

Where there is marked displacement of fragments which encroach upon the joint cavity there will naturally be some ankylosis no matter what the treatment, and the question of operative interference arises. Each case must be judged on its own merits as shown by the roentgen

examination, but the best results will usually be obtained when a conservative method of treatment has been followed, leaving the open operation for those cases of displaced fragment with limited motion in the joint, or the rare cases of non-union. If the plate shows a fragment so greatly displaced, that if left in position it will result in partial ankylosis, or is in danger of becoming a foreign body through non-union, it had best be removed by operation.

Bardenheuer states that he has never found it necessary to operate on a case of this fracture.

In 1910 Rabourdin stated:

With the exception of fissures with slight or no separation of fragments, it can be stated that the prognosis of these fractures is not very good from a functional point of view.

Many different forms of treatment have been used. Some cases have been treated by massage and early immobilization and still others by an open operation. Seven of the patients among the 37 on which this thesis is based were treated by massage and early mobilization. In 5 of these cases there was a limitation of movement. Immobilization was used in 4 of these cases and satisfactory results were obtained.

An open operation was performed either early or late in 7 cases. Secondary resections were made in 5 other cases.

Many authors favor early mobilization with or without massage. However an incomplete ankylosis occurs in many cases in which mobilization has been too hasty.

Immobilization has the advantage of relieving pain but should not be used in all cases. Good results are obtained in cases in which there is a simple fissure without any great separation of the fragments and without much deformation. However mobilization should not be used in all varieties of this fracture. It is not possible to obtain a perfect position of the fragments if an apparatus of any kind is used.

An open operation may be performed immediately or when other methods of treatment have failed. A secondary operation usually gives good results and it has the advantage of being simpler than an early operation because the tissues are not contracted or infiltrated with blood. However in certain cases in which there is a great displacement of the fragments, an immediate operation is the method of choice. It has the advantage of acting on the fracture itself and also on the articulation. The operation consists in the removal of fragments and spinters. In most cases the fragments are too large and too mobile to be fixed in place. The elbow joint should be opened and any blood should be removed. An early operation diminishes the temporary incapacity and may prevent later complications.

It is absolutely necessary to extract all spinters and perfect hemostasis should be obtained. The arm should be immobilized to a sling for about a week and then careful mobilization started.

Two years later (1912) Hiltzot (15) reported 29 cases of fracture of the head and neck of the radius. Of these 19 involved the head and 10 the neck.

In 18 cases without displacement the arm was supported by a posterior splint, baking begun on or before the third day and massage on the fifth day. Splints in

flexion and extension were begun as soon as the swelling subsided usually about the tenth day. Pronation and supination were begun about the fifteenth day. Result. Flexion and extension were complete in all cases. In 2 cases (chipping off the radial side of the head) pronation and supination were so slightly altered as to be classed as perfect. In 11 cases pronation and supination were half that on the normal side. In 1 of the same type as the first two cases mentioned, but with a line of fracture beginning well to the ulnar side of the articular surface of the head and extending outward through the head, supination was one-quarter and pronation one-half normal. Both the latter cases have some pain during supination and pronation.

In the 4 cases with displacement of the fragments the X ray was necessary for the diagnosis of the displacement. In 1 the head was broken into three fragments, two of which were displaced anteriorly while one remained in position. In this type the entire head was removed by cutting through the neck about one-half inch below the articular surface of the head and removing the head.

In the 3 remaining cases the head was broken in one place only and the fragment which was radially placed was displaced outward and forward and in this type the fragment only was removed.

The after treatment was similar in other respects to that pursued in the fractures without displacement.

Results. The resulting motion was better in those cases in which the head was removed (i.e. the neck cut through at the lowest possible level). In the case last mentioned supination was present to seven-eighths the normal and pronation was complete. In the other cases of complete removal, supination was two-thirds normal and pronation seven-eighths normal.

In the 2 cases of partial removal of the head, supination was one-half normal, pronation two-thirds normal, and pain was present during either movement in one of the cases for nearly a year.

The 10 cases of fracture of the neck were all transverse in type and involved that portion of the shaft about one-half inch below the head. The X ray was used to confirm the location of the fracture and in none of these cases was there any marked displacement.

Treatment. With the arm in mid-position between pronation and supination a U-shaped plaster splint was applied and left on for from 3 to 5 weeks. Massage was begun on the tenth day and passive motion and rotation at the end of the third week.

Results. Pronation was complete in 2 cases, and in these 3 supination was also nearly complete. In the 8 other cases, pronation was two-thirds normal and supination five eighths normal.

In 1914 Darrach expressed the opinion that when loose fragments involve a considerable portion of the internal aspect of the head of the radius it is wiser to remove the whole head as such. Otherwise the changes at the superior radio-ulnar joint would materially interfere with pronation and supination.

Jones (18) stated in 1915

Fractures of the neck of the radius may occur with or without dislocation of the head of the radius forwards as to the front of the capitulum or external condyle.

Treatment. (a) For the simple fracture of the neck the treatment is full flexion of the elbow with the forearm supinated. (b) When the head is dislocated as well as

broken off the displaced head may impede free flexion. The simplest treatment is to remove it. The lump of callus which forms around the broken end of the neck forms an excellent head under the molding forces of the ordinary movements of the part.

Fracture of head of radius. Fracture of a portion of the head is not uncommon. It is very apt to interfere with supination.

Treatment. The rule is to manipulate until supination is easily attained. If failure results then the loose piece can be removed. One of the chief causes of "clicking" elbow is malunion of a small portion of the fractured head of the radius.

As late as 1920 Lequerniere and Delhern believed that 'Les fractures isolées de la cupule radiale sont très rares. Turner en 1905 n'en avait colligé que 48 cas en tout. Since they gave no other reference and must have meant T. Turner Thomas of Philadelphia one wonders whether this excellent monograph was available for their use.

Hitzrot in 1920 (16) called attention to the possibility that the subluxation of the head of the radius described as a lesion in children under three years of age (Stimson and Jones and Lovett) "may in certain cases be a separation of the epiphysis not readily detected even by X ray. This author made the same division as Tanton

1. Fractures of the head of the radius. These include all which occur in the region of the upper radio-ulnar joint capsule and include the epiphyseal separations.

2. Fractures of the neck of the radius. These include only those fractures that involve the bone below the region of the joint capsule and above the attachment of the biceps tendon.

The present authors agree with this division as previously stated.

Grossman (1923) stated that where a fragment has been separated and displaced so as to block flexion of the forearm and it cannot be reduced by conservative measures, operative interference may become necessary whereby the offending fragment is either replaced in its proper position or removed. Storck (1924) believed that the demonstration of a loose fragment forms an indication for a surgical removal. Driberg (194) stated

In those cases in which the head of the radius is displaced, so as to cause mechanical obstruction, it is advisable to excise the displacement fragment without delay and to start massage, etc. immediately after operation. If operation is postponed there is liability of osteoarthritis and other joint and bony changes developing.

In the "mushroom" type of fracture massage movements, and exercises are usually sufficient to bring about a good result, but in some cases the flattening of the head of the radius causes considerable thickening and excess callus formation. If therefore at the end of a fortnight's treatment there is still decided limitation of flexion and

supination, I think it is advisable to operate and remove the head of the radius, taking care to get a full range of movements while the patient is under the anæsthetic.

Kellogg Speed, in 1924 (28) cites the detrimental results of excision but does not mention replacements. He says

In children with growing bones and in infants, resection is not indicated. One must not interfere with the epiphysis for fear of growth deformity and the loss of function is naturally overcome in great degree. (Length of time required is not stated.) Exceptions lie in ankylosed joints or those in which there is tendency to much new bone formation. After such resection in such children or adults, we use a modified arthroplasty by means of transplanted fascia.

Speed (27) again expressed his opinion in June, 1924 as follows

Non-operative treatment is indicated in adolescents and children with fractures of the neck of the radius, even if decapitation of the bone has resulted from fracture. By direct pressure the loosened fragment may be forced into something approaching a normal relation with the rest of the bone and the forearm can be swung up and splinted in a position of complete flexion. After 4 or 5 days, active motions are begun with an especial attempt to re-establish pronation and supination. Baking massage and electrical treatments are strongly indicated. A happy functional result, with some loss of range of motion, may be anticipated in most cases. (Percentage not given.)

Sever (1925) discusses treatment without differentiation between children and adults. He states

The relation of the articular surface of the head (radial) to the ulna and to the capitulum does not seem to be of great importance, except as originally laid down, to a good functional arm. However if such a condition is found at once, i.e. an impaction with considerable displacement laterally and anteriorly of the head of the radius, no harm can result in attempting by an operation to replace (agreement with Grossman, 1933) the head in its proper position on the end of the radial shaft, and I believe that in most cases this should be done so as to restore as much as possible normal anatomic relations.

The fractures of the head which show in the roentgenograms that there has been a piece of bone "hipped off," or show a marked alteration of the plane of the joint surface, generally require, at least theoretically, an operation to remove the loose fragment that acts as a foreign body in the elbow joint. This loose piece may also block free joint motion when it is removed.

Fracture dislocations of the head of the radius, when there has been complete separation of the head and neck with displacement of the head, should be operated on and the head removed. This is not generally enough I do, however, but to secure free motion in supination and pronation, the neck of the radius should be removed nearly to the bicipital tuberosity after splitting of the orbicular ligament. The danger of the radius riding forward from the pull of the biceps, as the result of the escape of the neck from the orbicular ligament is not of sufficient importance to weigh against free supination and pronation, which is often as limited after incomplete removal of the head when the neck has been left, as before operation.

The more complete removal of the radius, following removal of the fractured head, will probably give a better end result. This procedure however is not indicated as routine in all cases, but only in those necessitating a complete removal of the head.

Fairbank (1925) briefly states

In fractures of the head and neck of the radius, if the displacement is not great, the elbow should be fixed in full flexion and the question of operation should be postponed till later. In many no operation is necessary. If, however, the whole or part of the head of the radius is grossly displaced, it should be removed forthwith.

C. W. Cutler Jr. (1926) presented an excellent summary of the results of conservative treatment and excision of the radial head. He states

Upon the basis of these results it would be manifestly impossible to make a satisfactory comparison between the operative and non-operative methods of treating fractures of the head and neck of the radius. The figures do indicate, however, that the closed method of treating simple cracks of the radial head produces satisfactory results. As regards fractures of the three other classes—(1) separation of one fragment (2) fragmentation, (3) fracture of the neck—it can only be said that each method has yielded some results that were good, as well as a few that were imperfect. It would seem, therefore, unwise to advocate excision in every case of fragmentation or fractured neck. This is especially true since the operative procedure itself is not free from danger. The technical difficulty of locating and removing a single displaced piece of the head, or of finding and extracting all pieces in a multiple fragmentation, may be considerable. In one case of the group at least, not all of the fragments could be extracted. In addition three of the patients operated upon suffered infection of the wounds, resulting in delayed convalescence and in impaired results in two. Considering also the fact that should the closed method fail of good results in appropriate cases recourse may still be had to surgical removal of the fragments, it would seem best to treat these injuries without operation except where definite indications for removal are present. Such indications would appear to be: (1) such displacement of a fragment or of the whole head as would interfere with full joint motion; (2) irreducible complicating dislocation of the radius or ulna or both; (3) malunion, ankylosis or impaired motion in old cases.

DeWaard (1926) is positive relative to indications for excision. He says

When the capitulum of the radius is completely detached, as well as displaced, it must be operatively removed, and the end result is then not quite so favorable as on conservatively treatment of simple fractures of the radial head. When the radial capitulum is not essentially displaced, it can be restored to its normal position by operative procedures. This portion of the elbow joint is not to be removed without urgent necessity. The good end-results obtained in children who were conservatively treated, indicate that this mode of treatment is here entitled to preference unless a strong displacement of the fragments require an operative intervention. 1. In view of a good future function, the preservation of the radial head is indicated in operative interventions. The suggestion has been made, but it is not justified, to remove in case of detachment of a piece of the radial head, not only

this fragment, but the entire head of the radius. When the radial head is broken off as a whole, without more than a displacement being demonstrable in the roentgen picture, a replacement of the radial head in its proper position by operative measures is called for (agreement with Grossman 1933, Sever, 1933). The head of the radius is too important a portion of the elbow joint to justify its removal without urgent reasons, such as a comminuted fracture with shattering and splintering of the bone.

Flab (1929) reported 50 cases seen between 1922 and 1928. Twenty five were treated by the closed and the other 25 by the open reduction method.

Fractures, separations, and fractures without dislocation must be treated conservatively by means of an elastic bandage hot air baths, and massage. The results are good. Dislocated fractures must be treated surgically. The reduction and fixation of the head gives better results than extirpation (agreement with Grossman, 1933 Sever 1935 DeWaeerd 1936) the latter is the method of choice in compound fractures. The reposition gives excellent results. The extirpation is usually followed by some limitation of motion, especially in the sense of pronation and supination, and an occasional appearance of free joint bodies. The postoperative complications can be prevented to a great extent by padding of the radial stump with fascia obtained by a free transplant from the fascia lata.

Key, 1931 states

In children, if the displacement is slight, the fracture should be treated conservatively with the expectation that growth will correct the slight deformity. If the displacement is marked, open operation is indicated and this should be done as soon as practicable after the injury, but the head of the radius should not be removed as is recommended in adults for the same type of fracture (agreement with Grossman, 1933 Sever 1935 DeWaeerd, (33) 1936, Flab 1929).

In children the head can be manipulated or picked out and put back in its normal position on the neck and held in position by placing one or two sutures of fine catgut in the periosteum of the neck and then suturing the annular ligament around it. In this operation it is important that the elbow and forearm be placed in a position in which the head is fairly stable on the neck (a flexion of 45 degrees in a midposition between pronation and supination in my cases). After the head is placed in position, the forearm should not be moved until the wound is closed and the posterior plaster mold has hardened. This is of great importance so slight movement may not displace the head which is fixed very insecurely on the neck.

Within the past year I have replaced the head in 3 cases in children and both now have approximately normal motion in flexion, extension, pronation, and supination, normal power in the forearm and no pain. I have not attempted to replace it in adults.

The only contribution I feel I have made is the replacement of the head in children. In the literature I have not found that this has been done

From the chronological review above given it is evident that the advisability of replacing the radial head and neck to correct malalignment has been advocated by an increasing number of authors since 19 3

CASE REPORTS

CASE 1 B. L. S. M. H. No 62870 aged 11 years, white, schoolgirl, entered emergency division Strong Memorial Hospital, July 8, 1932. Twelve hours previously the patient tripped and fell on the floor on her extended and pronated left forearm. There was immediate pain and inability to use the elbow. The patient was brought to the hospital because, after 12 hours, the pain had still not abated. The past history was irrelevant. She had never previously broken any bones. General physical examination showed a well developed and nourished girl of 11 years. The various systems were negative. The left elbow was held in 90 degrees flexion with the forearm midway between pronation and supination. The forearm was supported by the right hand. There was moderate swelling about the elbow joint. Passive flexion and extension of the elbow were possible to 90 degrees and 145 degrees, respectively, without discomfort. Only a few degrees of passive supination were possible because of pain. There was marked pain on gentle pressure over the head of the radius with referred pain to the distal end of the radius. No abnormality in contour of the radial head could be made out. Roentgenograms of the left elbow showed a fracture of the left radius just below the proximal epiphysis with definite lateral and anterior displacement of the proximal fragment (Fig. 1).

Laboratory findings Hemoglobin 80 per cent white blood cells, 7,800 urine, clear yellow acid specific gravity 1.010 albumin, negative sugar negative microscopic, few white blood cells Wassermann reaction, negative.

Treatment. An open reduction was done at once under ether anesthesia. A linear incision was made on the lateral side of the forearm with its midpoint over the radial head. An impacted fracture of the radial neck was found. This had resulted in a displacement, anteriorly and laterally of the radial head. The deformity was corrected by leverage with a periosteal elevator at the line of fracture (Fig. 2). The impaction gave stability to the fragments. No internal fixation was used. The periosteum was closed with interrupted silk sutures. The remainder of the wound was closed in layers with the same suture material. The elbow joint was immobilized in 90 degrees flexion and full supination with a posterior plaster splint. The wound healed per primam.

The splint was removed at the end of 3 weeks. Physical therapy by means of baking, massage, and gentle passive motion, was commenced.

Seven weeks after operation the patient had a perfectly normal elbow joint (Figs. 3 to 6).

CASE 2 P. L. S. M. H. No 63243 aged 7 years, white schoolgirl entered the Strong Memorial Hospital emergency division, September 15 1932. Patient fell one hour before admission. The fall had been stayed by the pronated right hand, the elbow being in complete extension. The past history was irrelevant. She had never broken any bones previously. General physical examination showed a well developed and nourished girl of 7 years. The various systems were normal with the exception of the right elbow. The right elbow joint was held in 90 degrees flexion with the forearm in complete pronation. There was moderate swelling of the region with ecchymosis. On palpation there was an abnormal prominence in the region of the radial head and on gentle pressure over this area the patient winced with pain. Passive flexion was possible to 70 degrees and extension to 160 degrees without undue discomfort. Attempts at passive supination were painful and markedly limited. The patient complained of referred pain over the distal end of the radius as much as that produced by pressure of the index finger applied over the radial head and neck.

Laboratory findings were normal. Hemoglobin, 91 per cent, white blood cells, 8,400; urine, clear yellow alkaline; specific gravity .003; albumin negative; sugar negative. The sediment showed an occasional white blood cell. Wassermann reaction was negative.

Röntgenograms revealed a fracture of the radius just below the proximal epiphysis, with lateral and anterior displacement of the radial head (Fig. 7).

Treatment. On entry a closed reduction was attempted. This was not successful. Eight hours later an open reduction was done under ether anesthesia. A $\frac{1}{2}$ inch curved incision with its midpoint over the head of the radius and convexity toward the olecranon was made on the lateral side of the forearm. The head of the radius was found to be broken off completely and displaced anteriorly and laterally. It was replaced by gentle leverage with a periosteal lever between the fragments. The fragments remained in position even when the forearm was pronated or supinated or the elbow flexed or extended (Fig. 8). No internal fixation was used. The annular ligament was repaired and the wound closed in layers with silk. A posterior plaster splint was applied to immobilize the forearm in 90 degrees flexion and full supination. The wound healed *per primam*. The patient was discharged from the hospital on the eighth day after operation. Immobilization was continued for 4 weeks. Splint was then removed and the patient encouraged to use the arm. No physiotherapy was used.

Two months after the operation the patient had complete range of motion in the radioulnar joint (Figs. 9 & 10). Röntgenograms showed healing at the level of fracture.

CASE 3. J. B. S. M. H. No. 6835, aged 11 years, white schoolboy entered Orthopedic OPD of Strong Memorial Hospital, November 30, 1935. Two hours before entry the patient had been shoved out of a chair by another schoolboy. He fell upon his flexed left elbow. There was immediate pain in the elbow on attempts at motion. The past history was irrelevant. He had never sustained any fractures previously. Physical examination showed a well developed and nourished boy of eleven years. The anous systems were normal. The left elbow revealed slight swelling. The forearm was supported by the right hand. The elbow was held in 90 degrees flexion; the forearm midway between pronation and supination. Passive flexion and extension were limited by pain to 90 and 30 degrees, respectively. Passive supination was possible through about 5 per cent normal range. It was accompanied by definite crepitus over the radial head and curved pain referred to the region of the radial head and to the distal end of the radius. Gentle pressure over the radial head elicited no crepitus but caused referred pain to the two regions mentioned. No abnormality in contour of the radial head could be palpated.

Röntgenograms showed a separation of the proximal epiphysis of the left radius, displaced into the joint as if hinged posteriorly to the radius. There was an associated hair line fracture without displacement through the lateral epicondyle of the humerus (Fig. 1).

Laboratory findings: hemoglobin, 76 per cent; white blood cells, 8,450. Urine, cloudy yellow; specific gravity 1.014; alkaline; albumin, negative; sugar, negative; microscopic, occasional epithelial and white blood cells. Wassermann reaction was negative.

Treatment. The patient was admitted to the hospital on the following day and an open reduction was done under nitrous oxide gas-oxygen-ether anesthesia. A 3 inch incision, $\frac{3}{4}$ inch long, was made on the lateral side of the elbow with its midpoint over the radioulnar joint. The joint was opened. On doing so there was an escape of 25 to

30 cubic centimeters of thick dark blood. The epiphysis was found displaced far posteriorly and completely separated from the radial shaft except for a small posterior hinge. With some difficulty it was replaced in normal relationship with the radial neck. It was found to be quite unstable except when the forearm was placed in supination and the elbow in complete extension. This kept the epiphysis wedged between the radial neck and the epicondyle of the humerus (Fig. 14). The capsule of the joint was closed with interrupted silk sutures and the wound, in layers with the same suture material. The elbow joint was immobilized in complete extension and the forearm in supination, with a posterior plaster splint. The wound healed *per primam*. One week after operation the elbow joint was gently flexed to 90 degrees without anesthesia and a posterior plaster splint was applied. Röntgenograms following this revealed that the epiphysis had remained in normal position. Three weeks after operation this splint was removed and the patient encouraged to use the arm. No physiotherapy was used.

Two and one half months following injury the patient had complete flexion in the elbow: extension, 175 degrees; supination, 90 per cent; and pronation, normal (Figs. 15 to 18).

The patient had no symptoms, no motion crepitus could be felt in the joint. The X-ray negatives at this time showed the epiphysis in normal position. There were several minute bone fragments in the joint interpreted as being due to small fragments broken off at the original injury.

SUMMARY

Restoration of function in groups A and B with relation to treatment given

I Group A. Fractures within the radioulnar joint.

A. Fractures of the radial head.

1. Linear and chip fractures with little or no displacement.

a. Treatment. Immobilization at 90 degrees flexion with full supination 14 to 28 days, followed by massage.

(1) Result. All motions normal or only slight limitation in one or more.

2. Lines and comminuted fractures with displacement of one or more fragments.

a. Treatment: See A 1.

(1) Result. Moderate to severe limitation in pronation and supination, usually involving flexion and extension.

(a) Can be improved only by late resection of radial head and neck.

b. Treatment. By immediate operative correction of deformity. Three weeks immobilization as above. Baking and massage.

(1) Result. Minimum to moderate limitation in one or more motions. Probable prevention of resection of radial head and neck.

c. Treatment. If immediate operation reveals that deformity cannot be corrected, then radial head and neck should be resected.

3. Displacement of radial epiphysis.

a. Treatment. Immediate operative correction. Two to 4 weeks' immobilization.

May or may not be followed by physiotherapy

(i) Result Little or no limitation in pronation and supination. Flexion and extension normal.

b. Treatment. Conservative treatment always followed by definite impairment of function in two or more directions. Frequently requires resection of radial head and neck.

4. Linear fractures from radial head into neck.

a. Treatment. See A, 1 and A, 2

(i) Result. See A, 1 and A, 2

II. Group B. Fractures outside the radiohumeral joint.

A. Fractures of the radial neck between the level of the synovial membrane attachment and the insertion of the biceps tendon.

1. With minimum or no malalignment.

a. Treatment. Immobilization, 90 degrees flexion and full supination, 2 to 4 weeks, followed by baking and massage.

(i) Result. Little or no limitation of function in any motion of radiohumeral joint.

2. With definite malalignment.

a. Treatment. Operative correction of deformity. Immobilization, 90 degrees flexion, full supination 2 to 3 weeks, may or may not be followed by massage.

(i) Result. Little or no limitation in pronation and supination. Flexion and extension of the elbow normal.

b. Treatment. Conservative.

(i) Result. Invariably leads to disability which can be improved only by resection of radial head and neck.

III. Group C. It is obvious that the variations mentioned are included in the summary of groups A and B

CONCLUSIONS

Traumatic swelling on the lateral aspect of the elbow joint should direct attention to examination of the head and neck of the radius.

Intra articular or extra articular relationships which are detrimental to the restoration of function of the radiohumeral joint cannot be favorably influenced by manipulation and fixation. Immediate mobilization has been found equally detrimental to the restoration of function of this articulation.

The limitation of function which invariably follows these generally employed conservative measures has led to the necessity of frequent resection of the radial head and neck.

The head and neck of the radius are essential for stability of the elbow joint and maintenance of the normal carrying angle of 10 degrees.

The removal of the radial head and neck may improve pronation and supination but it is always followed by deformity in terms of an increased carrying angle, and relative instability of the elbow joint.

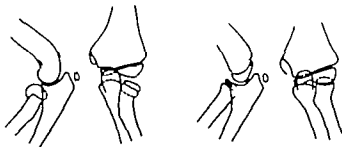


Fig. 1. Case 1. Tracing of roentgenograms of left elbow on admission, July 8, 1932

Fig. 2. Case 1. Tracing of roentgenograms of left elbow after operation, July 9, 1932



Fig. 3. Case 1. Flexion 5 months after operation.

Fig. 4. Case 1. Extension 5 months after operation.

Fig. 5. Case 1. Supination 5 months after operation.

Fig. 6. Case 1. Pronation 5 months after operation.

This paper is presented as additional evidence in support of the premise that immediate operation is indicated for the correction of (1) displaced radial epiphyses, (2) displaced fragments of the radial head (removal if necessary) and (3) malalignment of fragments in fracture of the radial neck.

Pressure with the index finger over the affected radial head and neck produces referred pain at the distal end of the radius. On the first observation of this clinical sign the severity of the pain directed the making of roentgenograms to deter-

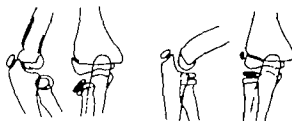


Fig. 7 left. Case 2. Tracing of roentgenograms of right elbow on admission. September 15, 1932.

Fig. 8. Case 2. Tracing of roentgenograms of right elbow after operation. October 4, 1932. The image shows two line drawings of a right elbow joint. The left drawing shows the joint in a flexed position, and the right drawing shows it in an extended position. Both show the joint after surgical repair, with the bones in a more normal alignment.

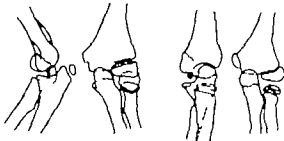


Fig. 13, left. Case 3. Tracing of roentgenograms of left elbow on admission. November 20, 1932.

Fig. 14. Case 3. Tracing of roentgenograms of left elbow after operation. December 3, 1932. The image shows two line drawings of a left elbow joint. The left drawing shows the joint in a flexed position, and the right drawing shows it in an extended position. Both show the joint after surgical repair, with the bones in a more normal alignment.

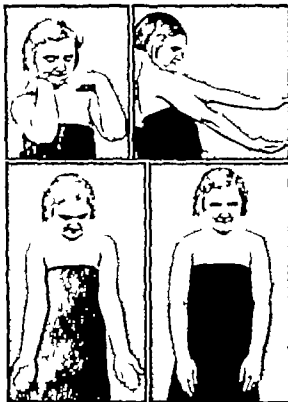


Fig. 9. Case 2. Flexion 3 months after operation.

Fig. 10. Case 2. Extension 3 months after operation.

Fig. 11. Case 2. Supination 3 months after operation.

Fig. 12. Case 2. Pronation 3 months after operation.



Fig. 13. Case 3. Flexion 3 1/2 months after operation.

Fig. 14. Case 3. Extension 3 1/2 months after operation.

Fig. 15. Case 3. Supination 3 1/2 months after operation.

Fig. 16. Case 3. Pronation 3 1/2 months after operation.

mine the presence or absence of injury to the distal third of the radius. This observation has been made in 5 successive patients, including the 3 which have been reported. We have found no report of this clinical sign in the 34 references quoted.

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NEPHROPEXY

PRESENT DAY STATUS AND DESCRIPTION OF A NEW TECHNIQUE¹

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AT the present time urologists of many different parts of the world have returned to the beneficent operation now known as nephropexy. Indeed, no operation has a more fascinating history. Its discovery was foreshadowed when Rayer noted that relief from the symptoms of movable kidney could be obtained by rest in bed and by mechanical support in the form of a pad or belt. Beginning with this observation surgeons began to make definite efforts to relieve this particular condition by surgical suspension of the kidney assuring its permanent fixation in the proper position. However due to mistaken choice of the operation for conditions not warranting its use in any way surgeons in general came for quite a period to cast doubt on the value of the operation and succeeded in discrediting its value. However the operation has survived.

The first attempt to secure a movable kidney was that of Dr. Greenville Dowell, of Galveston, Texas, who in 1875 attempted to secure the kidney by means of a seton. In 1870, Gilmore, another American surgeon, successfully removed a painful, atrophied, floating kidney from a 3 months pregnant woman by the lumbar region the second successful deliberate nephrectomy in history and the first surgical intervention on the kidney during pregnancy. In 1878 Martin popularized nephrectomy for the relief of movable kidney. Radical removal of the kidney gained some favor because it was an intervention that permanently cured the patient. It soon became apparent, however that this radical operation sacrificed a relatively healthy kidney could not be performed when the opposite kidney was damaged or involved by stone formation and when renal mobility was bilateral. With these facts in mind, Hahn, in 1881 conceived the idea of fixing the kidney by sewing the perirenal fat to the walls of the lumbar incision by suture. He called this operation nephrorrhaphy. Eight years later Le Dentu wrote his excellent work entitled "Affections du Rein et des Urètres" in which he devoted an entire chapter to surgical suspension of the kidney and in which he stated that the term nephrorrhaphy led to confusion as it signified suture of the kidney itself. For fixation of

the mobile kidney to the posterior abdominal wall by suture he introduced the term "nephropexy" which came from the Greek meaning to fix and to coagulate. This term was soon adopted and has been universally employed since that time. Hahn's original operation consisted of suturing the fatty capsule to the muscles of the lumbar incision. Although this operation did not give lasting results, it paved the way to the perfection of various types of operations that permanently relieved the patient. Surgeons soon began lending their efforts to the invention of numerous and ingenious methods of nephropexy. Many of these were never adopted or were soon given up for methods that afforded the highest percentage of lasting fixation. After the operation had been perfected so that the percentage of failures had been reduced to a minimum surgical suspension became exceedingly popular. Some surgeons eager to follow the new fashion, little heeded the criteria for operation advised by Albarrán and many other sane thinking urologists, namely pain, obstructive phenomena and gastro-intestinal symptoms, and began fixing movable kidneys that were causing no symptoms. Thus, then, nephropexy soon became the finishing touch, the master stroke of nearly every abdominal operation. The result—and a quite logical result—was that in many instances the operation gave little relief because it had been depended upon to relieve renal obstruction that did not exist. But this experience at once led numerous surgeons to give up the operation entirely. And thus the pendulum swung far and wide to such an extent that the patient suffering from severe attacks of Dietl's crisis due to strangulation of a movable kidney had difficulty in obtaining this due surgical relief. Unfortunately nephropexy is still held in disrepute by certain surgeons and urologists, who, in recent publications, emphasize the failure of this operation in cases in which as usual it had been wrongly applied and these surgeons, either willfully or blindly fail to recognize its unquestionable beneficent results in the numerous cases to which it is being intelligently and more correctly applied.

At the present time most of the surgeons performing nephropexy fix the kidney by means of

sutures taken through its substance or fibrous capsule or secure it by suture of the partially resected fibrous capsule. Some surgeons employ bands of muscle, fascia, or tendon secured from the surrounding structures in order to perform fixation. Suspension by support from below obtained by closure of the renal fossa by approximation of the perirenal fascia, fatty capsule and peritoneum, also has its advocates. Others employ the combined method of fixation in which they fix the kidney by sutures passed through the capsule, the parenchyma (Papin) or partially resected fibrous capsule and secure additional support from below by massing the renal fascia and peritoneum.

At the present time there seems to be some confusion as to the choice of the operative procedure to be employed in the relief of movable kidney presenting symptoms, and these symptoms it may be remembered are pain gastro-intestinal disturbances nervous phenomena and the persistent infection of the kidney resulting from faulty drainage. Very recently some surgeons notably Hess, Herbst, and others, claim that denervation or renal sympathectomy, alone, will relieve the patient of the symptoms of movable kidney. While this procedure unquestionably relieves the pain associated with this condition, it should be reserved for those cases of nephralgia in which faulty drainage due to stasis plays a minor rôle. If any. Nephropexy is the operation of choice in patients in whom movable kidney is causing marked symptoms, certainly in those in which the lowered position of this organ causes faulty drainage and persistent infection of the kidney and in those who cannot tolerate abdominal belts and mechanical supports.

The development of urography by means of which renal ptosis, ureteral angulation and back pressure changes in the kidney can be actually demonstrated on the X ray film afforded the clean cut scientific evidence necessary to point out the true indications for this operation with the result that surgeons no longer need be guided by misleading palpatory evidence. And further more, the quite recent intensive work on the ureter has revived and has again justified this beneficent operation which was almost lost to the profession.

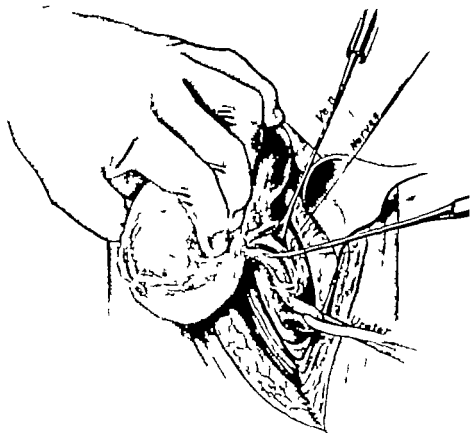
At the present time urologists of many different countries of the world have added their guiding influence in the development of nephropexy. In England we find Bell, in France, Marion, Chevassu, Papin, Heitz, Boyer, and Legueu, in Germany, von Lichtenberg, in Spain, Sánchez Covasa, Cifuentes and Miravet, in Cuba, Ledón and in our own United States, the late B. A.



Fig. 1. First step. A, Entire kidney is freed and delivered into the incision. The upper ureter is freed (ureterolysis) in order to eliminate any pressure that might be exerted thereon by aberrant vessels or fibrous bands. B Ureter dissected free.

Thomas, Bransford Lewis, Peacock, Fowler Lowale, Bissel, Burford Hinman, Scholl, Squier, Deming and Mathé. All of these men have added their bit to replace nephropexy on a sane and scientific basis and to make it take its proper importance among surgical interventions on the kidney.

But of course the ideal operation for surgical suspension of the kidney should be one that accomplishes fixation of the kidney in the renal fossa in a sufficiently high position by which free drainage from the kidney is assured and by which all kinks in the ureter can be obliterated. In rechecking various methods in vogue for this purpose the author observed that in some instances the kidney had not been fixed in a satisfactorily high position to make possible the best drainage and freedom from kinks in the ureter. This led the author to devise a new method for the regulation of the height of suspension of the kidney.



Ralph Sweet

Fig. Second step. Illustrates denervation or renal sympathectomy. The sympathetic nerve fibers are easily located on the superior surface of the renal artery or its main branches where they are severed. Exposure is facilitated by retracting the vein with a small retractor.

and by which one could replace this organ in an ideal anatomical situation assuring perfect drainage and lasting relief of symptoms. This method consists of fixation of the organ high up in the renal fossa by taking sutures in the fibrous capsule of the kidney and attaching them above the eleventh or twelfth rib.

Before describing this method it is well, in order that the need for a new and more satisfactory scheme of suspension may be fully understood to review the methods of surgical suspension by means of the fibrous capsule which have formerly been employed. It is interesting that all through these various and very similar methods it is possible to follow the fascinating history of an idea as it proceeds little by little to its present form as illustrated in the "present-day technique and status of nephropexy."

Basini, 1881, was the first surgeon to fix the kidney by means of its capsule. In the same year Robert Weir of New York independently carried out a similar technique to that of Basini in performing the first recorded nephropexy in the United States. In 1888 Duret, of Lille proposed his method of fixation by the fibrous capsule. These surgeons emphasized the fact that one should fix the kidney by passing sutures through the more resistant true capsule rather than through the rather loose fatty capsule. As a result of experimental work conducted by Basini, 1887; Vannieuville 1888 and Tuffier 1889 in which it was definitely proved that fixation by means of sutures passed through the parenchyma of the kidney caused no lasting damage to this organ, surgeons soon began fixing the kidney by means of sutures passed through its substance. This



Fig. 3. Third step. A triangular twenty day chromic catgut suture is passed through the fibrous capsule on the anterior surface of the upper pole of the kidney leaving two outer bridges on the convex surface of the kidney

method of suspension gained considerable favor and fixation by means of sutures passed through the capsule of the kidney was not revived until the beginning of the twentieth century, when Goelet, in 1902, described his method and declared that it was not necessary to pass sutures through the kidney substance nor was it wise to remove its fibrous capsule in order to secure fixation.

While Goelet was working on this method of securing the prolapsed kidney, Max Brödel of Baltimore, well known anatomical artist, devised his triangular suture later known as the Brödel stitch which was passed through the renal cortex and fixed to the quadratus lumborum muscle. Howard Kelly soon adopted Brödel's triangular suture of fixation by the fibrous capsule and was

among the foremost kidney surgeons of the United States to point out the beneficent results obtained by performing nephropexy in indicated cases. His guiding influence and keen judgment has done much to place nephropexy on a firm basis in this country.

Although Kelly's method has given him and his numerous pupils excellent results, the author observed in checking his personal results from its use by pyelography that the kidney was not always fastened in a satisfactory position. Likewise the other methods heretofore described by which the kidney was fixed by sutures taken in its fibrous capsule gave excellent result in many cases, yet in some instances it did not replace the kidney high enough in its fossa nor in its normal anatomical position. These very uncertain ele-

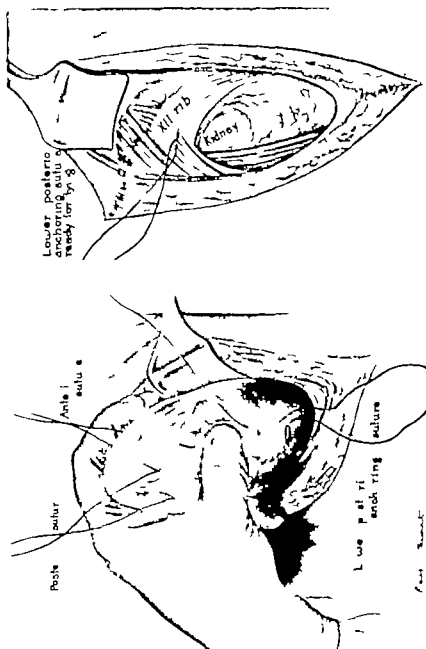


Fig. 4.

Fig. 4. Fourth step. Similar triangular sutures are taken on the posterior surface of the capsule in the region of the upper and lower poles of the kidney.

Fig. 5.

Fig. 5. Fifth step. Ligation of the upper anterior and posterior sutures above the twelfth rib. In cases in which high suspension is desired, these are placed at a lower level on the kidney and are ligated above the twelfth rib. Not the ligation of the lower posterior anchoring suture to musculature below the twelfth rib, which prevents turning of lateral displacement of the kidney.



A.

B.

Fig. 6. A, Pyelogram taken of a patient aged 31 years, presenting second degree renal ptosis. In the pre-operative pyelogram one remarks the lowered position, torsion of the kidney and early hydronephrosis. B Pyelogram taken

6 months after the author's method of nephropexy. Note high fixation in the normal anatomical position by which the ureter has been straightened and good dependent drainage of the kidney assured.

ments of the old operations which led the author to seek to devise a more satisfactory operation, one by which the kidney can be fixed at any height desired by which it is entirely freed from the surrounding structures and assuring that the upper portion of the ureter can be readily exposed. This last is to eliminate any back pressure on the tube from adhesive bands or aberrant vessels which left untouched might defeat the purpose of the operation.

As may be seen the idea which threads through all the efforts of these many surgeons was the idea that a means could be discovered by which a satisfactorily high suspension could be achieved and maintained, a lasting fixation of the movable kidney in a position which would insure good drainage of urine and relief from symptoms. With this idea as a goal the author perfected a technique which he recommends and presents in detail as a successful and beneficent method for satisfactory suspension and fixation of movable kidney.

AUTHOR'S METHOD OF NEPHROPEXY

The usual curvo-linear Albarrán incision is made extending from the costovertebral angle toward the anterior superior spine. The kidney is entirely freed from the surrounding structures (nephrolysis) delivered into the incision and liberated from sclerizing fibrosis or fibrolipomatosis that might be present usually due to an accompanying perinephritis. A triangular 20-day absorbable chromic catgut suture is taken in the anterior and posterior surface of the kidney either in the region of the upper pole, the mid region, or in the junction of the mid region and lower pole depending on the height of fixation desired. The triangular suture is taken in the renal capsule in such a manner as to leave two outer bridges on the surface of the kidney and in the most advantageous position where it would counteract forces tending to bring the kidney to a lower level. The direction of the suture is made so that it is at right angles and not parallel to the framework of the cortex (Fig. 3). Suspension at a greater height

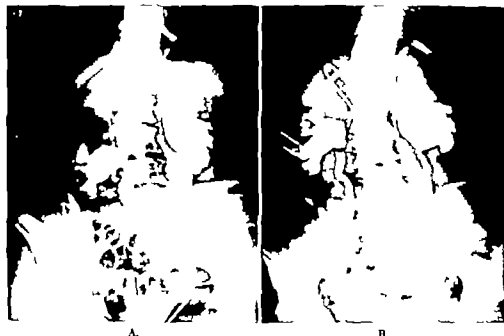


Fig. 7. A, Female, aged 5 years, presenting marked gastro-intestinal symptoms, nervous disturbances, and repeated attacks of Diel's crises. In the pre-operative pyelogram, taken in the dorsal position, one notes bilateral third degree ptosis with marked kinking of the ureter and hydrocephrosis. B, Pyelogram taken after operation demonstrating satisfactory fixation of both kidneys in high position, unimpeded drainage of the kidneys and regression of hydrocephrosis.

can be obtained by placing the sutures lower down in the kidney. These sutures are more easily passed through the musculature above the twelfth rib by employing a Reverdin needle where they are ligated separately. In cases requiring very high suspension the upper anterior and posterior sutures are tied above the eleventh rib and in passing the Reverdin needle downward in order to draw up the fixation suture it is well to keep close to the posterior surface of the anterior wall of the thorax in order to avoid injury to the pleura. In this way one can obtain high fixation of the kidney thereby taking up any slack that might exist in the ureter, assuring straightening of any kinks that might be present in this tube. A third suture is taken in the posterior surface of the kidney about 3 centimeters below the upper posterior suture, and is anchored to the musculature below the twelfth rib in order to steady the kidney and in order to prevent torsion or lateral displacement of this organ. The upper portion of the ureter is routinely dissected free from the surrounding structures (ureterolysis) in order to eliminate any pressure that might be exerted thereon by aberrant vessels, fibrous bands, etc. which, left untouched, might defeat the purpose of the operation. In cases presenting an unusual

amount of pain, denervation of renal sympathectomy is also performed. This consists of severing the sympathetic nerve fibers which are usually found to course along the superior surface of the renal artery and its main branches. Exposure of the renal artery is facilitated by retracting the renal vein with the use of a small retractor which is shown in Figure 2.

In cases in which there is a concomitant perinephritis in which the fibrous capsule consists of a thickened, indurated sclerotic shell, partial decapsulation is performed in order to relieve strangulation of the kidney. A small longitudinal incision is made in the capsule on the anterior convex surface of the lower pole of the kidney. The capsule is partially stripped and this is sufficient to release the kidney and does not in any way interfere with the integrity of that portion of the renal capsule on which the fixation sutures are taken. A soft rubber tissue drain is placed against the posterior surface of the lower pole of the kidney and it is brought out through the upper portion of the skin incision. It is gradually withdrawn about a centimeter each day in such a way that at the end of a week it is entirely removed. The patient is kept in bed in the Trendelenburg position for 3 weeks assuring

adhesion of the kidney to the walls of the renal fossa in a high position

The results obtained from employing this method on numerous cases in St. Mary's Hospital in the French Hospital, and in the Southern Pacific General Hospital in San Francisco have been very satisfactory. Routine postoperative pyelographic study has demonstrated that the kidney had been permanently fixed in a sufficiently high position by which the ureter had been freed of kinks and thus good dependent drainage of urine was definitely established. Relief from symptoms by the employment of this method has surpassed the use of all other methods formerly employed by the author

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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OCTOBER, 1933

THE PRESENT STATUS OF RA DIUM THERAPY IN CANCER OF THE UTERUS

RADIUM therapy at the present time is being weighed in the scale of experience against surgery in the treatment of cancer of the uterus. In considering the value of a mode of treatment it is essential that we differentiate clearly cancer of the cervix from cancer of the fundus. In about 10 per cent of cases, cancer originates in the cavity of the fundus uteri usually as adenocarcinoma. Cancer of the fundus is more frequent after the menopause the mean age incidence being 8 years more than in cancer of the cervix.

The ordinary panhysterectomy gives an average 5 year cure rate of 60 per cent in these cases and is therefore the method of choice, but unfortunately on account of senility obesity cardiovascular disease diabetes many of these patients are poor surgical risks, so that we must resort to intra-uterine radiumtherapy and X ray which give a cure rate closely approaching surgery. Probably in these patients the ideal method is to com-

bine radiationtherapy and surgery when possible.

In cancer of the cervix all authorities agree that surgery is of little avail unless the radical operation of the Wertheim or Schauta type is employed. This operation can be done only in cases classed as operable. For the inoperable class, which includes more than 50 per cent of those seeking relief surgery has nothing to offer.

In competent hands radiumtherapy combined with high voltage X ray in advanced cases gives results which are fully equal to the 5 year results obtained in surgery in the "operable" patients the primary mortality rate being less than 2 per cent as compared to the 8 to 17 per cent in radical surgery. For the inoperable cases radiumtherapy gives an average 5 year cure rate of 12 to 18 per cent and has in the majority of cases a definite value in the palliation and prolongation of life.

A 5 year cure rate of approximately 35 per cent may be obtained in cancer of the cervix uteri by either radical surgery or radiumtherapy in all those applying for relief. In the early cases in which the disease is limited to the cervix, a 50 per cent or better 5 year cure rate may be expected.

The radical Wertheim operation requires skill and experience to be properly performed and it must not be confused with the usual operation of complete or panhysterectomy which is frequently done for carcinomas of the cervix. The difference between an ordinary hysterectomy and the radical operation may be readily understood when compared to a simple mastectomy and the modern radical

operation for carcinoma of the breast. Simple hysterectomy for cancer of the cervix is followed by fatal recurrence in nearly 100 per cent of cases.

The safe use of radium, however, requires judgment and experience. A thorough understanding of its action and an appreciation of the complexities of its safe and efficient application is necessary otherwise we assume a grave responsibility in not giving these sufferers the full benefit of our present day knowledge. If a correct dosage and filtration is used the cancer cells will be destroyed but *not* the normal tissues. If too great a dosage and insufficient filtration is employed, the normal structures will also be destroyed producing extensive necrosis, septic absorption, hemorrhages and fistulas and perhaps death. If too small a dosage is used there will be a failure to destroy all the cancer cells.

Radium is therefore a two-edged weapon and proper training and experience in the treatment of cancer of the uterus by radium therapy is just as essential as in surgery.

Madame Curie has called attention to the great dangers of the improper use of radium, and Regaud has sounded a warning that "it is necessary to have much experience to obtain from this method of treatment all the good that it may give without the evil that it may do."

The difficulties of the safe employment of radium may be likened to Virgil's lines,—

There on the right her dogs foul Scylla hides,
Charybdis roaring on the left presides.

GEORGE GRAY WARD

COMPOUND FRACTURES

A COMPOUND fracture nearly always places the surgeon "on the horns of a dilemma." Two problems confront him: first, a broken bone, the treatment of

which suggests one fairly well recognized set of procedures, and, second, a wound of the soft parts, usually infected, calling for an other generally accepted mode of treatment. Unhappily, these indicated methods of treatment are frequently contradictory, and the problem arises thus: Shall the wound be treated first, and then the fracture, or shall the fracture receive primary consideration? Or can the two be treated simultaneously?

Our teachings here have lacked harmony. To some men treatment of the wound is always primary, the fracture itself can wait. Others, especially orthopedic surgeons, have been unwilling to neglect the fracture and have attempted various compromises in the effort to treat both the fracture and the wound at once. It is apparent however that neither the one policy of treating the wound first and then the fracture, nor the other of endeavoring to treat both at once—that is to say, if the wound is treated by the usual antiseptic methods now in vogue—has given us the results that should be obtained in such cases. Recent developments in the management of compound fractures and other infected wounds suggest, however, that combined treatment of fracture and infected wound is possible, and that such a plan of treatment conforms to sound surgical principles. We shall return to a discussion of this plan later.

First let us summarize the fundamental principles of therapy in compound fractures. In the treatment of all fractures, *as fractures*, the attempt is made, first, to effect an immediate restoration to correct length and position of the fractured part, second, to maintain that correct length and position during the period of healing, and, third, to afford complete rest to the injured part both to preclude muscle spasm and pain and to facilitate the healing process by avoiding disturbance of the forces

of repair. To make these principles effective we employ various devices which will insure rest, immobilization and maintenance of correct position with an eye to ultimate restoration of function.

Our treatment of the wound apart from the fracture has called for compliance with other principles of therapy. These include first primary asepsis or antiseptics to exclude or reduce infection, second drainage and third wound treatment to prevent, reduce or control infection of the wound. But here arises the dilemma. The usual methods of treating the wound conflict with what we know should be the correct treatment of the fracture and in the methods now generally employed there is no solution of this conflict.

Some surgeons as we have said prefer to treat the wound first and the fracture secondarily. This means delay in reducing the fracture, disturbance, for antiseptic dressings or treatment of whatever fixation or immobilizing apparatus is used, irritative movement of the injured and inflamed part, frequent exposure of the wound surface to injury and infection and too often failure to obtain union of the fracture or union in malposition.

Of those methods hitherto employed, which attempted a compromise and endeavored to deal with fracture and wound at the same time we can say only that it has been our observation that they have sacrificed the best principles of treatment for one or the other and have led to results as poor as those described above. To afford access to the wound, control in splints has been sacrificed and there has been no true immobilization. There has thus been no efficient maintenance of fracture fragments, no real protection against muscle spasm and no provision for rest for the patient. Moreover the wound itself—and here is the chief reason for failure—has been treated too much. We have failed to appreciate that

the wound surface also requires protection and rest and that frequent flushings and dressings do more harm than good. Those compromise methods of treatment, therefore, which call for complicated splinting devices arranged to permit daily or more frequent dressing of the wound or plaster-of-Paris casts with large windows to allow for the insertion of Carrel-Dakin tube dressings and irrigations, fail to observe principles of fracture therapy which are fundamental: rest, immobilization, protection against new infection and the others which have been listed.

Our own experience with the treatment of osteomyelitis in all its forms has convinced us that both the fracture and the wound in infected compound fractures can be treated with full observance of the correct surgical principles which we have outlined. We have demonstrated that frequent dressings, irrigations, and other disturbances of the wound are unnecessary, indeed, they violate these principles. By dispensing with such procedures we are able to control both the fracture fragments and the patient and to facilitate healing of the wound. We use plaster-of-Paris casts combined with our method of "closed drainage" the wound is packed open with sterile vaseline gauze, while the fracture is controlled when necessary by ice tongs, pins, or mole skin traction straps which are included in the plaster cast. Nor do these devices have to be disturbed at any time during the course of treatment. These are really effective as traction and immobilizing devices.

It may be admitted that skeletal devices used in conjunction with Thomas splints and Balkan frames have in the hands of fracture specialists such as Sinclair and Pearson and in such special fracture clinics as the one at the Massachusetts General Hospital, given satisfactory results. But this has depended largely upon the exceptional skill in their

original application and the careful supervision throughout treatment made possible by the kind of after care we developed in a few of the military hospitals in 1918-1919. With most surgeons, however, due to a lack of similar skill in applying the original apparatus, to difficulty of controlling the patient during treatment, and to all of those factors which tend to separate the patient from his original attending surgeon this sort of treatment leads to poor results.

Some surgeons too, have been able to show good functional results in patients whose fracture fragments were permitted to heal in malposition, but it can hardly be argued that this is a safe course to follow routinely. Several writers have urged less-than perfect reduction, particularly in children, on the theory that compensatory adjustment of both length and position will occur in the course of growth. Even in adults occasional good results may be had. Extensive studies indicate, however, that healing in correct anatomical position must be obtained if a high percentage of good functional results is to be expected. And in view of the widespread use of the X ray in checking results and the growing frequency of suits

for malpractice, it is becoming increasingly evident that we must make a better showing — anatomically and functionally — than we have in the past.

We believe, then, that we are now in a position to fulfill simultaneously the surgical requirements for sound treatment of compound fractures and their associated infected wounds. We believe that there should be a more extensive use of these fundamentals of surgery: first, adequate primary reduction of the fracture itself, second primary cleansing of the wound by debridement, third, provision for "closed drainage" that is, efficient drainage under a well fitting plaster cast, fourth, fixation by means of efficient skeletal devices included and immobilized in plaster of Paris and fifth, discontinuance of programs of frequent antiseptic flushings or dressings which disturb the healing wound and, all too often, introduce new and secondary infection. It has been shown that such a plan of treatment can be well standardized and used routinely. If this is done the results of treatment will afford us all, both patients and surgeons, considerably more satisfaction than they have in the past.

H. WINNETT ORR

EARLY AMERICAN MEDICAL SCHOOLS

THE DEVELOPMENT OF THE HARVARD MEDICAL SCHOOL

TRACY J PUTNAM M.D. Boston

FROM a perspective of three centuries it sometimes seems strange that so many years should have elapsed between the founding of Harvard College in 1636 and the beginnings of medical education there in 1782. It should be remembered, however, in the first place that at the time the New England colonies were settled, the science of medicine was in chaos the world over. The soundest medical training which was to be had was an apprenticeship with an older physician of intelligence and experience. Didactic teaching was merely supplementary to practical but fragmentary experience. Such a situation persisted until within the memory of men now living.

In the second place the poverty of most of the early settlers and the sparse and scattered nature of the population almost precluded sole dependence on medicine as a livelihood. Usually the minister had a smattering of medicine either picked up by chance observation or as a result of the brief medical studies often included in the courses of theology.¹ Until well into the eighteenth century the majority of non-clerical physicians were farmers in the intervals of their professional duties. Further the University shared in the general stringency and its funds barely sufficed for the support of its three professors.²

With the great awakening of interest in science which took place in the middle of the eighteenth century it was but natural that some thought should be given to the establishment of medical teaching at Harvard. Gifts of medical books, anatomical specimens and the like began to be recorded and it seems obvious, though nowhere expressly stated, that the officers of the College had in mind instruction in some branches of the study of medicine. In 1770 Ezekiel Hervey a physician of Hingham, left one thousand pounds to the College for the express purpose of aiding

in the support of a professor of anatomy and physic.³ About this time also, dissections began to be carried on in a rather clandestine way by groups of undergraduates. The actual founding of a chair of anatomy was delayed, however perhaps for lack of a suitable incumbent, but doubtless also on account of the unsettled political situation until 1782. The lamentable condition of the military medical services during the Revolution was fresh in everyone's mind; medical schools had been founded in Philadelphia and in New York. New England was entering upon a period of prosperity⁴ and John Warren had appeared upon the scene.

John Warren, the first of four generations of the same name⁵ to serve the Harvard Medical School, was the younger brother and pupil of Dr. Joseph Warren, who refused the title of surgeon general of the Massachusetts forces to die in the ranks at Bunker Hill. John Warren himself rendered invaluable services as superintending surgeon to the military hospital in Boston, at the age of 24 years. In the army he had met Morgan, the founder of the University of Pennsylvania Medical School and was familiar with Morgan's inspiring book on the needs and methods of medical education. Although his formal education in medicine was scanty he had a profound knowledge of anatomy in addition to rare ability as a surgeon and teacher. With these gifts he combined the imagination to plan an institution for the future needs of the community and the courage and persistence to fight for it against all obstacles. Willard, the president of the College, turned to him for advice in formulating a program for the new courses in medicine, and there was little surprise (though much envy) among his colleagues when he received the appointment of professor of anatomy and surgery on November 22, 1782.

¹This frequent deviation during the Revolution and the Heavy pre-
sionship of anatomy and physic was endorsed in 1791 by his father
and his brother.

²Alison Warren, the third in line, though an outstanding person,
had no connection with the Harvard Medical School. Thomas Dwight,
Parkman professor of anatomy from 1823 to 1830, was also direct
descendant of John Warren.

Thomas Cotton Mather, dean emeritus, was largely responsible for the
introduction of small pox inoculation in Boston by Dr. Zabdiel Boylston
at almost the same time that Lady Wortley Montagu introduced the
practice in England.

Occupying the chairs of divinity, mathematics, and natural sci-
ences, respectively.



Fig 1 John Warren—Hersey Professor of Anatomy and Surgery 1782-1815



Fig 2 John C. Warren—Hersey Professor of Anatomy and Surgery 1815-1847



Fig 3 John Collins Warren—Moseley Professor of Surgery 1899-1907

The new professor's duties proved arduous. During the 4 months course of lectures he had to leave a busy practice and drive from Boston to Cambridge—then a long journey. He did his own dissecting delivered a lecture often lasting 3 hours and returned. In addition, he had to provide the cadavers, some of which it is to be feared were come by in devious ways.

Two other professors were appointed a little later. The professor of theory and practice of physic was Dr Benjamin Waterhouse. He was also a young man, the nephew of Fothergill of London, and largely trained abroad. A rather confused picture of his personality has been handed down to us. There can be little doubt but that he was pompous and quarrelsome, but this should not make us forget his scholarly attainments, which were ahead of his day. He championed the cause of vaccination, for example, and won local recognition of its virtues at a time when the remainder of the world was incredulous—the first important scientific achievement of which the new school could boast.

The third member of the medical faculty was Dr Aaron Dexter, professor of chemistry and materia medica—a distinguished physician and able teacher.

A student who attended—or at least bought tickets for—the 4 months course of lectures and



Fig 4 John Warren—Associate Professor of Anatomy 1910-1918.

demonstrations given by these three gentlemen, in addition to the regular college course, received the degree of Bachelor of Medicine. To acquire a doctor's degree he had to go abroad to study.¹ Meager as this training seems when judged by modern standards, it was not very different from the type of instruction offered in the Old World. There was for example only one medical college in England and the course consisted of 72 lectures.

A new standard of medical education was formulated in the early years of the nineteenth century by two young

men, just returning from studies abroad. Dr John Warren's son John Collins Warren and James Jackson. They were of about the same age and had come to form a close friendship while studying at St. Thomas in London under William and Astley Cooper—a friendship which lasted throughout a long lifetime. Warren resembled his father; he was an energetic, determined reformer, a totaler and a scientist of rigid standards. Jackson "the beloved physician," had a more serene, warmer and more sympathetic temperament. The difference is reflected in their published works. Warren's masterpiece is his *Surgical Observations of Tumours* (1837) perhaps the ablest treatise on surgical

¹ A few honorary degrees were awarded, chiefly to established practitioners.

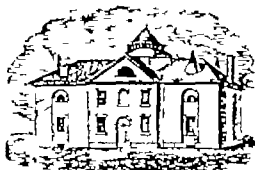


Fig. 5 The Massachusetts Medical College 815.

pathology of the pre microscopic era. Jackson's *Letters to a Young Physician* (1855) are a series of essays on the philosophy and art of clinical medicine, quite unsystematic but charming and full of hints of value to every physician now as then. Warren among other achievements recorded the first successful operation for golfer in this country, founded the School's pathological museum and performed the first operation under ether in public. Jackson recommended the open air treatment of tuberculosis and described alcoholic neuritis. Both had high ideals of medical practice and education, and their talents were mutually complementary.

Largely through the efforts of the Warrens, Jackson and a few other open minded physicians, the necessity of further provision for clinical instruction was impressed on the Corporation of the University. At this time, the only institution in the vicinity available for clinical instruction was the almshouse in Boston. On this account and because of the greater number of physicians in the larger city, it seemed expedient to move the medical institution there. The change was made in 1810. The younger Warren had already been appointed his father's assistant, and now Jackson was made professor of clinical medicine. The lectures were given in rented rooms over the store of White, the druggist, at 49 Marlborough Street.⁷¹ Two years later Waterhouse resigned, no longer on speaking terms with the rest of the faculty as the result of an unfortunate controversy and Jackson was appointed to the chair of theory and practice of physic in his place.

The city almshouse was lamentably deficient for teaching purposes, and the temporary rooms in which medical lectures were held were thoroughly unsatisfactory. In 1810 Jackson and Warren circulated an appeal for funds to build a suitable General Hospital, but donations came

Now Washington Street.

slowly. Petitions to the State legislature and to the Corporation of the College for a more suitable building for didactic instruction were granted in 1814, and the following year a small, but for the period well equipped school was completed on Mason Street, near the Common. As the State had contributed so largely to its expenses, its name was changed from 'The Medical Institution of Harvard University' to 'The Massachusetts Medical College.' Harvard contributed a small sum to its maintenance and had a correspondingly small control over its affairs. For the most part it was a private venture—financially unprofitable—on the part of the Faculty which undertook to meet the upkeep of the building and materials for instruction out of fees received directly from students.

The death of John Warren the founder of the school, occurred in the same year.

In 1821 the Massachusetts General Hospital was finally built. The story of this institution, which has played so large a rôle in the development of medicine in America, will be told in a later article in this series. The facilities for clinical instruction now became equal to any in the country and pupils were attracted from all parts of the United States.

An important accession to the faculty of this period was Jacob Bigelow professor of materia medica. He was a man of broad culture and many interests, a botanist as well as a physician, the founder of the great Mt. Auburn cemetery (the first of its kind in the country) and the father of Henry Jacob Bigelow. His most noteworthy medical contribution was his paper on *Self Limited Diseases* which went far toward bringing an end to the days of "a pill for every ill."

Even with the new equipment and an unusually able group of lecturers, the lack of a longer course and of individual study made itself felt. To meet this need, a number of private medical schools arose during the first half of the century. While they varied greatly in quality some of the better ones grew to be recognized as contributing greatly to medical education. The most famous one, the Tremont Street Medical School, which included in its faculty such renowned teachers as Oliver Wendell Holmes, Henry J. Bigelow, Jr., Miles Wyman, and Charles and J. B. S. Jackson, finally incorporated into Harvard as the Summer School.

Aside from inevitable changes in the faculty which cannot be reported here, the school continued without fundamental change until 1846. In that year three important events occurred.



Fig. 6. Oliver Wendell Holmes, Parkman Professor of Anatomy and Physiology 1847-1882.



Fig. 7. Henry J. Bigelow Professor of Surgery 1839-1882.

The first, which marked the beginning of a new era in medicine, was the demonstration of the anæsthetic properties of ether. The sordid personal details of this magnificent discovery are familiar to all and need not concern us further. The two others were of local significance only but represented a turning point in the history of the school. One was the transfer to a new building, and the other was the accession of a group of brilliant young men to the faculty.

It had been obvious for some time to everyone concerned that the little building on Mason Street, in spite of enlargements, was too small for its purpose. Money was accordingly advanced by the University to build a new one, and was to be repaid by the proceeds of the sale of the old. The balance still owing was to be paid off gradually by the faculty of the medical school. Accordingly, a much more commodious building was erected on the site of the present out-patient department of the Massachusetts General Hospital, on land presented to the school by Dr. George Parkman, a wealthy practitioner. Three years later it was the scene of his murder by Dr. John Webster, Erving professor of chemistry. But that is a story aside from our present narrative.

About the time that the School moved to its new quarters, three new professorships were created, one combining anatomy and physiology, one of anatomy alone, and one of pathology—the first in the country. The significance of this change was not alone that further instruction was given in the fundamental preclinical sciences.

A greater innovation was that the new professors did not merely teach in the intervals of private practice, but devoted all their working hours to study and instruction—the beginning of the full time system. The choice of men to be thus honored was particularly happy. Oliver Wendell Holmes was chosen for the chair of anatomy and physiology, Jeffries Wyman for that of anatomy and John B. S. Jackson for that of pathology.

No more than a hint can be given here of Holmes' many-sided genius. He was probably the wittiest lecturer that has ever adorned the University. Anatomy is still enlivened by some of his apt metaphors and droll companions. He was beloved by his students and in turn considered no labor too great which would simplify his subject or make it more interesting. He had talent for original observation and invention, as is shown by his essay 'On the Contagiousness of Puerperal Fever' (1843), by his demonstration of the cells in bone (1847) and by his ingenious stethoscope and student's microscope. But he preferred teaching. In addition to anatomy and physiology, he lectured on microscopy and psychology. In 1857, he founded *The Atlantic Monthly* with James Russell Lowell and from that time on became increasingly engaged in literary pursuits.

Jeffries Wyman was also a good teacher, but his chief interest was in his anatomical laboratory. He was an incessant worker and published no less than 175 articles on comparative anatomy. He was the first to describe and name the gorilla (1845), among other achievements.

John Barnard Swett Jackson was also a devoted scientist. His publications are few but he has left a monument in his arrangement of the Warren Anatomical Museum which was donated to the school in 1847. His catalogue of the Museum, published in 1870 is in reality a text book of pathology.

In 1849 Henry Jacob Bigelow was appointed to the chair of surgery. He was the first to publish an account of Warren's operation under Morton's ether and made many contributions to the subject of anesthesia. His best known innovations in surgery are his method of reducing dislocations of the hip by taxis and his instruments for lithotomy. If his lectures lacked the sympathy and wit of Holmes or the scientific depth of Wyman's, they made up for it in brilliance and wealth of demonstration. His clinical judgment and operative dexterity were unsurpassed. Tall, handsome, well dressed and driving a French chaise with horses in tandem he was known by sight to every inhabitant of the city. He exercised a sort of benevolent tyranny over the school, hospital and practice of surgery throughout New England.

There was a gradual expansion and improvement in the School for the next two decades and the addition of such able practitioners to the faculty as George Cheyne Shattuck, Henry I. Bowditch, John Ware, Humphreys Storer and Calvin Ellis. The Boston City Hospital was opened in 1864 and added its profusion of clinical opportunities to the resources of the School.

The basis of operation of the School remained essentially what it was under Warren and Jackson—a private institution supported by students' fees with scarcely more than a nominal connection with the University. Original investigation was a by-product. The aim of the School was to supplement the instruction in practical medicine that could be acquired by assisting an older physician. The course of lectures was the same each year. To be examined for a degree in medicine, a candidate had to show that he had bought tickets for two such courses of lectures and had spent 3 years with a practicing physician. The examinations were given by the teachers who gave the courses and received the fees and the candidate needed to pass in only a majority of subjects to receive his degree. This was the case not only at Harvard—where fairly high standards were maintained—but throughout the country and in many schools with miserable equipment and commercial ideals. The Chicago Medical College in 1859 introduced a 3 year graded course with required hospital attendance but this was a solitary example.

A protest was made in 1866 by James C. White, later professor of dermatology. He pointed out the low general standard of medical practice and the fact that the only really qualified teachers of medicine were those who had gone abroad to study where medicine seemed a strange, almost a new science to them, and where years might be spent in learning what was then taught in but a single subdivision of one of the old general departments.

The real cataclysm came in 1870 following the accession of Charles W. Eliot to the presidency of the University. He had a first hand knowledge of the methods of the medical school, as he had acted as lecturer in chemistry there in 1856. No description of the transformation could equal that which Holmes has left us.

Our new president, Eliot, has turned the whole University over like a flapjack. There never was such a head-over-heels as that in our Medical Faculty. The Corporation has taken the whole management of it out of our hands, and changed everything. We are paid salaries, which I rather like, though I doubt if we gain in pocket by it. We have, partly in consequence of outside pressure, remodeled our whole system of instruction. Consequently we have a smaller class, but better students, each of whom pays more than under the old plan of management. It is so curious to see a young man like Eliot, with an organizing brain, a firm will, a grave, calm dignified presence, taking the ribbons of our classical couch-and-six feeling the loosest morsel, putting a check on this one's experts, and touching that one with the lash—turning up everywhere, in every faculty (I belong to three) on every public occasion, at every dinner *and*, and taking it all as naturally as if he had been born President.

Reform was bitterly and doggedly opposed by Bigelow and by those of the Faculty that owed their positions to him. In an able defense of the established position, Bigelow said on one occasion:

Whatever else it may do or not do, a medical school should aim first, then to give a plain, sound, solid education, without error if without ornament. For in the first place, you cannot do better than this. It is the highest average development of which the mass of the material you are dealing with is susceptible, in view of the character of its preliminary education and of the accepted three years term of study. In the next place, you need not do better. Without good judgment, for which education is not a substitute, if you fill the mind of the student with Chemistry and Physiology and Drugs, as leading ideas, the chances are that he will apply this collateral, imperfectly applicable knowledge wrongly and that he will be a to forget and abandon much of it before he gets down to a working medical level. Medical discovery is generally not made by workers in chemical and physiological fields, but by subsequent and more purely medical workers, who apply to disease the materials and results of such previous work.

The school would be the loser if the simple practical point of view here expressed were ever

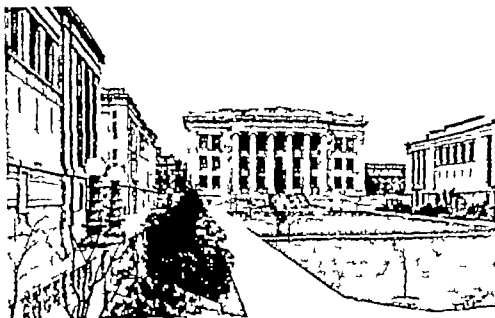


Fig. 8. The Harvard Medical School.

lost sight of. Fortunately it has not proved incompatible with the results of reform.

Elliot had his way. The president of the University became an active member of the faculty of medicine and all appointments had to pass the Overseers and Corporation of the University. The school's funds were received and disbursed by the university, though still under direction of the faculty. The course was lengthened to 3 years, the length of the usual college course, and the instruction was graded for each class. Each student was required to perform a certain amount of laboratory and clinical work. Examinations were required to pass from one class to another and for graduation. The school was thus placed on a full university basis and the modern era of medical education was begun.

The expansion of the faculty necessitated by the new order and increased year by year up to the present, makes it impossible even to mention all the names of the procession of eminent practitioners, able scientists, and revered teachers, who maintained the standards set by the founders of the school. I can give only an outline of the physical changes and developments in policy of the school and the more outstanding scientific discoveries of the last 60 years.

The expansion of the curriculum brought about by the new order led to the creation of professorships of a number of specialties at that time scarcely recognized in this country. Chairs of dermatology, mental diseases and ophthalmology were established in 1871, occupied by White Tyler and Williams, respectively. A particularly

important development was the inauguration of a physiological laboratory for teaching purposes under Henry P. Bowditch in 1871—apparently the first one in America. Bowditch was made a full professor in 1876 and retained this title until 1906.

Instruction was begun in other special subjects, such as pediatrics, laryngology, and otology, though on a smaller scale. As the school was now intended to replace teaching by apprenticeship, the amount of individual instruction and section work underwent a progressive increase which still continues. Meanwhile, the tradition of didactic teaching by lectures and demonstrations was ably carried on by Francis Minot in medicine and David Cheever in surgery.

The new order made the Grove Street building immediately out of date. Fortunately a large fund of gifts and bequests was available for the construction of a new one. Construction was begun in 1881 at the corner of Boylston and Exeter Streets, next to the site of the present Public Library. The total project cost over \$300,000. The building was dedicated in 1883, the centenary of John Warren's first lectures.

A fourth year of instruction was made optional in 1881 and compulsory in 1891. The requirements for premedical education were stiffened and an examination was given before matriculation. About this time, the Lying-in Hospital, the Children's Hospital, and the Free Hospital for Women, in succession permitted instruction to students within their walls. The chairs of gynecology under Baker, of laryngology under

Knight, and of otology under Blake were all established in 1883. Bacteriology was recognized for the first time in this country by the appointment of Harold Ernst as demonstrator in 1885 and professor in 1895. Under his direction, J. Collins Warren prepared and used sterilized dressings in 1887. Two particularly famous departments were established in 1893: those of pediatrics under Rotch and of orthopedics under Bradford. The same year a department of diseases of the nervous system under James Putnam offered instruction in neurology as well as in psychiatry. Among the outstanding teachers of this period were Thomas Dwight, in gross anatomy; Charles S. Minot, in embryology; Reginald Fitz in medicine, and Maurice Richardson, in surgery.

The requirements for admission to the medical school were increased in 1901 to include the degree of A. B. or its equivalent. The step did not prove an unqualified success. It was felt by many members of the faculty that some students who for one reason or another were not able to spend 4 years at college were in fact more desirable candidates than others who had complied with the new standards. Accordingly in 1916 the requirements were altered to the extent that a man who had done the equivalent of 3 years' college work and stood in the first third of his class would also be eligible for admission. This amount of flexibility has proved highly satisfactory.

The fruits of expansion were seen in investigative work as well as in instruction. The pathological and clinical picture of acute appendicitis was firmly established about this time by Fitz. Bowditch demonstrated the non-fatigability of nerve in 1892. Cannon took the first X-rays of the digestive tract in 1897 and Theobald Smith differentiated between human and bovine tubercle bacilli in 1898. During this period Rotch was developing his important percentage system of infant feeding.

As the end of the century approached, it became obvious that the Boylston Street building was already growing too small. Funds were therefore again solicited for a more extensive plant. Something over \$4,000,000 was collected, Morgan and Rockefeller being the largest donors. A tract was purchased just beyond the Fenway at that time surrounded by most repellent dump heaps. Enough land was acquired to accommodate the Dental School, Children's Hospital, and a university hospital at a later date. The funds were raised and plans were made largely by J. C. Warren and H. P. Bowditch.

A description of the beautiful group of five buildings which was completed in 1906 would be

superfluous. They still afford adequate space after a quarter of a century and plans are ready to double their capacity if the necessity should arise.

The need for a hospital intimately connected with the medical school had long been felt. A bequest from Peter Bent Brigham became available for this purpose shortly after the opening of the new buildings. The hospital called by his name, was built adjacent to the school and opened in 1913. About the same time, the Children's and Infants Hospitals were moved to new buildings near the school. Just across the street, a new Living-in Hospital was built in 1924 and a most comfortable dormitory for students in 1918. The sumptuous Beth Israel Hospital was opened the following year only a minute's walk away. The opportunities for clinical instruction now offered at Harvard are equalled by few schools, in this country or abroad.

Of recent scientific achievements, perhaps the most outstanding have been the contributions of Dr. Harvey Cushing to the surgery of the nervous system and physiology of the hypophysis, of Dr. George R. Minot and William P. Murphy on the treatment of pernicious anemia with liver of Dr. S. Burt Wolbach on the etiology of Rocky Mountain spotted and typhus fever and of Dr. Hans Zinsser on the etiology of typhus. The buffer system of the blood has been worked out by Dr. Lawrence J. Henderson, and Dr. Walter B. Cannon has filled out the gaps in the physiology of the sympathetic nervous system. The funds available for investigation have steadily increased and the extent of research projects now in progress is far beyond the scope of this paper.

The history of the Harvard Medical School has been one of constant growth—not so much in the number of students, for there were classes larger than the present ones in the Boylston Street days, but in resources, instructors, and investigators. The school already offers far more facilities for instruction than any one student can use. If growth continues, what will the school of the future be like? Will it become more and more an institution for research until medical education dwindles to a by-product? That would be a loss to research. Will it undertake to offer instruction to a larger number of students, by continuing formal instruction through the summer as has been several times suggested? Perhaps, but the proportionate increase in funds limited to research may continue nevertheless. Will it lay more emphasis on graduate study not necessarily in classes, but by extending the facilities of laboratories and clinics to increasing

numbers of qualified graduates who desire further special opportunity and individual instruction? We may be sure at all events that the School will not stand still.

NOTE.—Most of the material for this sketch has been drawn from Harrington's compendious history (*The*

Harvard Medical School: a History Narrative and Documentary, New York: Lewis Publishing Co., 1905, 3 vols.) to which I gratefully acknowledge indebtedness. I have also drawn on biographies and shorter articles too numerous to mention in detail. Dr. David Cheever has been good enough to revise the manuscript and add many suggestions.

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

THE tenth *Scientific Report of the Imperial Cancer Research Fund*¹ presents the results of investigations conducted during the past 3 years by various members of the laboratory staff.

Ludford found the lowering of resistance to the growth of transplantable tumors to be the result of some interference with the function of cells derived from lymphocytes and monocytes which segregate acid dyes. These cells are seen in large numbers around the margins of absorbing tumors and are particularly common in tumors that have been exposed to radiation. These observations indicate the possible danger in the treatment of cancer with colloids under circumstances in which the body may be offering some resistance to the malignant process.

Ludford also studied the differential reaction of normal and malignant cells *in vitro* to Trypan blue and observed that malignant cells do not segregate this dye in the same manner as non-malignant cells when both are subjected to the action of the dye under identical conditions in tissue culture. The cells of filterable tumors fail to take the vital stain *in vivo* or *in vitro* whereas their non-malignant prototypes segregate the dye. Ludford suggests that the failure of malignant cells to segregate acid dyes may be due either to their impermeability to these substances or possibly to some peculiarity of metabolism possessed by the cancer cell.

Fould studied the effects of vital staining upon the distribution of the Brown Pearce rabbit tumor and discovered that tumors are rarely found in the spleen and are relatively uncommon in lungs and liver. Vital staining with Trypan blue greatly increased the incidence of tumors in all these organs after intravenous inoculation. The author suggests that the spleen in man retains the establishment of secondary deposits by a local mechanism. There is considerable evidence to support the view that the cells of the reticulo-endothelial system play a predominant rôle in this mechanism.

Cramer has studied the mode of action of radium upon precancerous lesions and finds that radium delays and sometimes inhibits the development of cancer in an area of skin which is the seat of a precancerous state. Investigations were made in an effort to determine whether the application of radium breaks down the resistance of normal skin

to the development of cancer. No evidence could be adduced to support this view.

Cramer also conducted further studies upon the therapeutic action of radium and concludes that regression of tumors following irradiation occurs as the result of a combined effect upon the tumor cells and upon the tumor bed. These observations are supported by Ludford's cytological studies from which it appears that in addition to a direct action of radiation upon tumor cells, there is an important effect of radiation upon the stroma and particularly upon the blood vessels.

Interesting experiments are reported by Crabtree upon respiration and carbohydrate metabolism of irradiated tumor cells *in vivo* and *in vitro*. The author finds that radium causes a lowering of the respiratory function of cells and to a certain extent of their glycolytic function also. Radium irradiation exerted no differential effect upon metabolism of tumor tissue as against normal tissue. The conception that tumor cells are inherently more vulnerable than normal tissue fails to be supported by these studies. (Clinical and pathological evidence strongly support the view that certain tumor cells which we term radiosensitive are inherently more vulnerable to radiation than are normal cells.)

M. A. COOPER

THE sixth edition of Zachary Cope's *Early Diagnosis of the Acute Abdomen*² bears evidence of both the author's desire to keep the text up to date and of the welcome reception that the book has received. The fact that no considerable alteration has been necessary is indicative of the firm ground upon which the work is based. As is so typical of the English school of surgeons, the author's diagnoses are based, in so far as possible upon our knowledge of anatomy and physiology of the abdomen and its contents with somewhat greater emphasis placed upon anatomy than upon physiology. The book is not encumbered with numerous complicated tests or descriptions of questionable and confusing diagnostic procedures, but contains a clear, practical, and concise discussion of the disease conditions which comprise the acute abdomen, or which may be confused therewith. The volume will long remain a classic monograph.

MICHAEL L. MARON

¹TENTH SCIENTIFIC REPORT ON THE INVESTIGATIONS OF THE IMPERIAL CANCER RESEARCH FUND. Under the direction of the Royal College of Physicians of London and the Royal College of Surgeons of England. London: Taylor and Francis, 1933.

²OXFORD MEDICAL PUBLICATIONS. THE EARLY DIAGNOSIS OF THE ACUTE ABDOMEN. By Zachary Cope, B.A., M.D., M.S. (Lond.), F.R.C.S. (Eng.) 6th ed. New York and London: Oxford University Press, 1933.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

J BENTLEY SQUIER New York *President*

WILLIAM D HAUGARD Nashville *President Elect*

FRANKLIN H. MARTIN Chicago *Director-General*

PHILIP H. KREUSCHER *Chairman* OSCAR E. NADREAU *Secretary Committee on Arrangements*

PROGRAM FOR THE 1933 CLINICAL CONGRESS IN CHICAGO

CLINICAL CONGRESS PROGRAM IN BRIEF

Sunday October 8

7:00. Health meeting, A Century of Progress.

Monday October 9

10:00. Hospital conference.
12:00. Clinics in hospitals.
1:00. Hospital conference.
2:00. Surgical film exhibition.
4:30. Fracture demonstration, illustrated.
8:15. Presidential meeting.

Tuesday October 10

9:00. Clinics in hospitals.
9:30. Hospital conference.
10:00. Surgical film exhibition.
11:30. Fracture demonstration, illustrated.
12:00. Clinics in hospitals.
2:00. Demonstration in administration at hospitals.
2:00. Surgical film exhibition.
3:30. Symposium on treatment of fractures.
8:15. Scientific session, general surgery.
8:15. Scientific session, section on otolaryngology.

Wednesday October 11

9:00. Clinics in hospitals.
9:30. Hospital conference.
10:00. Surgical film exhibition.
11:30. Fracture demonstration, illustrated.
12:00. State and provincial executive committees.
1:00. Clinics in hospitals.
2:00. Demonstration in administration at hospitals.
2:00. Surgical film exhibition.
3:30. Symposium on curability of cancer.
4:30. Fracture demonstration, illustrated.
8:00. Community health meeting—Chicago Stadium.
8:15. Scientific session, general surgery.

Thursday October 12

9:00. Clinics in hospitals.
9:30. Hospital conference.
10:00. Surgical film exhibition.
11:30. Fracture demonstration, illustrated.
12:00. Annual meeting of College.
1:00. Clinics in hospitals.
2:00. Demonstration in administration at hospitals.
4:00. Reception at American College of Surgeons.
4:30. Fracture demonstration, illustrated.

8:15. Scientific session, general surgery.
8:15. Scientific session, section on ophthalmology.

Friday October 13

9:00. Clinics in hospitals.
10:00. Surgical film exhibition.
10:00. Meeting of new Fellows, class of 1933.
11:00. Symposium on urological surgery.
11:30. Fracture demonstration, illustrated.
2:00. Conference on industrial medicine and traumatic surgery.
2:00. Clinics in hospitals.
2:00. Surgical film exhibition.
4:30. Fracture demonstration, illustrated.
8:15. Convocation.

THE surgeons of Chicago will present for the twenty third annual Clinical Congress of the American College of Surgeons October 9-13 a program of clinics and demonstrations in the hospitals and medical schools that will provide a complete showing of the clinical activities in all departments of surgery in this great medical center. They are keenly interested in outdoing all previous efforts and in making its plans the Committee on Arrangements has the hearty co-operation of the clinicians in the medical schools and more than fifty hospitals that will participate in the clinical program.

A schedule of operative clinics and demonstrations as prepared by the Committee is presented in the following pages. It will be noted that clinics are scheduled to begin at 2 o'clock on the afternoon of October 9 continuing through the four following days with sessions both morning and afternoon.

The clinical program contains many features of special interest including (1) Cancer clinics demonstrating the treatment of cancer cases by surgery, radium and X ray. (2) fracture clinics where modern methods in the treatment of fractures will be demonstrated. (3) clinics in trau

matic surgery demonstrating the newer methods of rehabilitation by surgery and physiotherapy of patients injured in industrial, automobile and other accidents.

The clinical program as published at this time is merely an outline or basis for the final program, as during the Congress the clinical program will be published daily in the form of bulletins prominently displayed on large bulletin boards at head quarters at the Stevens Hotel. These bulletins will be posted each afternoon showing in complete detail the clinics to be given on the following day. The same material will be published in the *Daily Bulletin* for distribution to the visiting surgeons early each morning.

Special features of the general program for the Congress include (1) A conference on fractures on Tuesday afternoon arranged by the College Committee on the Treatment of Fractures (2) a symposium on the curability of cancer on Wednesday afternoon (3) a symposium on urological surgery on Friday morning (4) a symposium under the auspices of the Board on Industrial Medicine and Traumatic Surgery on Friday afternoon. Complete programs for these conferences and symposia appear in the following pages.

CANCER IS CURABLE SYMPOSIUM

An outstanding feature of this year's Congress - of great interest to all cancer workers and to the public as well - will be a symposium on the curability of cancer to be held in the ballroom of the Stevens Hotel at 2:30 o'clock on Wednesday afternoon. This will be participated in by a group of clinicians who are especially interested in the treatment of this disease. Each speaker will record his five-year cures of cancer. Clinicians who participate will furnish incontrovertible evidence that cancer is curable emphasizing that if all cases of cancer were treated in the incipient stage the annual cancer death rate of the United States might be reduced one third or from 150,000 to approximately 100,000. The program will be found on a following page.

EVENING MEETINGS

Programs for a series of seven evening meetings in the ballrooms of the Stevens Hotel will be found in the following pages.

At the presidential meeting on Monday evening at which the president-elect Dr. William D. Haggard of Nashville Tenn. is to be inaugurated a number of distinguished visiting surgeons from foreign countries are to be presented. Among those who have indicated their intention of being present are Prof. R. Marshall Allen

Melbourne, Australia. Dr. Lorenz Boehler Vienna. Prof. Dr. Eugen Kisch, Berlin. Prof. Rudolf Nissen, Berlin. Prof. Vittorio Putti, Bologna, Italy. Prof. Dr. Wolfgang Rosenthal, Leipzig, Germany. Prof. H. Beckwith Whitehouse, Birmingham, England. A feature of this session will be the annual John B. Murphy oration in surgery to be delivered by Dr. Loyal Davis, of Chicago, whose subject will be "The Story of a Master Surgeon."

At the annual Convocation of the College on Friday evening at which the 1933 class will be received into Fellowship in the College the Fellowship address will be delivered by Robert Maynard Hutchins, A.M. LL.D. president of the University of Chicago. The presidential address at the same session will be given by Dr. William D. Haggard of Nashville, Tennessee.

Two sessions of special interest to ophthalmologists and otolaryngologists will be held in the north ballroom of the Stevens Hotel on Tuesday and Thursday evenings, at which meetings men of outstanding experience in these specialties will present and discuss papers.

FRACTURE CONFERENCE AND DEMONSTRATION

Under the auspices of the College Committee on the Treatment of Fractures, Dr. Frederic W. Bancroft, New York, chairman, a conference has been arranged for Tuesday afternoon at 2:30 in the ballroom of the Stevens Hotel. The detailed program therefor appears on a following page.

The treatment of fractures will also be the subject of daily demonstrations in the Exhibition Hall as arranged by the Chicago Regional Fracture Committee. Illustrated talks on fractures by members of this Regional Committee will be given twice daily at hours to be announced in the *Daily Bulletin*.

Dr. W. Edward Gallie, of Toronto, will deliver the annual fracture oration on Wednesday evening his subject being "The Treatment of Fractures Involving Joints."

CONFERENCE ON INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY

During the past three years the College has conducted investigations and surveys in large areas of the United States to ascertain present medical conditions in industry and to inform employers of adequate methods. Results of these surveys will be presented by investigators in the symposium at 2:30 Friday afternoon in the ballroom of the Stevens Hotel under the auspices of the Board on Industrial Medicine and Traumatic Surgery of which Dr. Frederic A. Beasley is Chairman.

Other papers in the symposium deal with the clinical aspects of injuries occurring in industry, and methods of rehabilitation of the injured, presented by surgeons of wide experience in this field. The complete program appears on one of the following pages.

COMMUNITY HEALTH MEETING

In recognition of its obligation to the public to provide authoritative information on modern surgery, better hospitals, and prevention of disease, a community health meeting will be held on Wednesday evening October 11 in connection with the Clinical Congress. For this purpose the Chicago Stadium which will accommodate approximately twenty thousand has been secured. A program appropriate for such an occasion has been prepared consisting of brief interesting talks on scientific medicine, health, and hospitals by speakers of note. The complete program for this meeting appears on another page.

ANNUAL HOSPITAL CONFERENCE

The program for the sixteenth annual hospital conference arranged by the Hospital Standardization Department of the College as presented in the following pages presents a group of interesting papers, round table conferences and practical demonstrations that deal with the important problems related to hospital efficiency.

The conference opens at 10 o'clock on Monday morning in the ballroom of the Stevens Hotel continuing on Tuesday, Wednesday and Thursday. Papers will deal with the vital problems affecting administrative, professional and the nursing phases of hospital work, with particular emphasis directed toward professional standards and the highly important problem of medical economics.

Sessions will be held in the ballroom of the Stevens Hotel on Tuesday, Wednesday and Thursday mornings, while for the afternoons an important and interesting series of demonstrations in several of the local hospitals dealing with departmental organization, management and function has been arranged. These clinics in hospital administration afford unusual opportunities for the visitors to see how local hospitals handle their daily routine and in comparison to appraise the efficiency of their own methods.

The program of the conference has been carefully planned to give it a broad interest with a careful selection of subjects to be discussed by eminent authorities in the surgical and hospital field. Greatly increased interest on the part of surgeons in both administrative and scientific

phases of hospital work has been evident in recent years. The program to be presented this year will be unique in providing a discussion of many subjects of importance to the three major groups of the hospital—medical, nursing and business. An opportunity is also afforded to chiefs of staffs, heads of departments and members of staffs to participate in a program dealing particularly with the care of the patient, and they may expect to benefit from an exchange of ideas with trustees, superintendents and others concerned with hospital administration.

SURGEONS' WEEK AT A CENTURY OF PROGRESS

A Century of Progress has made an admirable and fitting contribution to medicine and surgery through the medical exhibits in the Hall of Science. Since the opening of the exposition many thousands of people have viewed these exhibits with intense interest and have gone home with a more rational viewpoint of scientific medicine.

Another contribution by A Century of Progress will be Surgeons Week commencing October 8, which will be opened by a large assembly in the court of the Hall of Science on Sunday evening when an appropriate and interesting program will be presented following the Arcturus ceremony. Among other interesting features of this program will be addresses by distinguished surgeons from Central and South America, Australia, Great Britain and the Continent. Throughout the week at A Century of Progress talks and radio broadcasts will be given by Fellows of the College in connection with the daily program. All the Fellows of the College, their families and friends are invited to attend the Sunday evening assembly in the court of the Hall of Science.

STATE AND PROVINCIAL EXECUTIVE COMMITTEES

A meeting of the State and Provincial Executive Committees with officers of the College has been called for 11:30 o'clock Wednesday morning at the Stevens Hotel. This meeting is called for the purpose of obtaining information on which may be based the itinerary of the College for its sectional meetings and the desirable grouping of the states and provinces.

EDUCATIONAL AND SCIENTIFIC EXHIBITS

Departmental activities of the College will be demonstrated by means of a series of exhibits located in the Exhibition Hall. These include exhibits by the Committee on the Treatment of Fractures of which Dr. Frederic W. Bancroft, of

New York, is chairman. Committee on the Treatment of Malignant Diseases, Dr. Robert B. Greenough, of Boston, chairman. Registry of Bone Sarcoma, Dr. Dallas B. Phenister, Chicago, chairman. Cancer Clinics, in charge of Dr. Bowman C. Crowell. Associate-Director of the College Hospital Standardization, in charge of Dr. Malcolm T. MacEachern, Associate Director of the College Department of Literary Research.

TECHNICAL EXHIBITION

An extensive technical and educational exhibition under the direction of Mr. A. D. Ballou, General Manager of the Clinical Congress, will occupy the Exhibition Hall on the lower floor of the Stevens Hotel. This exhibition will include surgical instruments and apparatus of all kinds, hospital laboratory, X-ray and other diagnostic and therapeutic equipment, medical books, pharmaceuticals, etc. A visit to the technical exhibition will provide many suggestions for improving the environment of the surgeon including the newest in physical, therapeutic and mechanical innovations.

SURGICAL FILM EXHIBITION

Throughout the week surgical motion picture films, both sound and silent, will be exhibited daily at the Stevens Hotel. This showing of films demonstrating clinical features of interest has met with popular acceptance in previous years. Many new films are to be shown. Detailed programs will appear in the *Daily Bulletin*.

MEETING OF NEW FELLOWS

Candidates for Fellowship in the American College of Surgeons, class of 1933 will assemble in the grand ballroom of the Stevens Hotel at 10 A. M. on Friday for the necessary instructions previous to receiving their Fellowships.

RECEPTION AT THE COLLEGE

A reception and tea for Fellows of the College, their ladies and guests of the Clinical Congress will be given on Thursday afternoon from 4 to 6 o'clock at the American College of Surgeons, 40 East Erie Street.

REDUCED RAILWAY FARES

In the states east and southeast of Chicago and in the eastern provinces of Canada, the railways have authorized reduced fares on the certificate plan on account of the Clinical Congress so that the total fare for the round trip will be one and one third the ordinary one way fare. To take advantage of these reduced rates it is necessary

to pay the full one-way fare to Chicago procuring from the ticket agent when purchasing ticket a convention certificate which certificate is to be presented at headquarters for the signature of the General Manager of the Clinical Congress and a visé of a special representative of the railways. Upon presentation of a visé certificate to the ticket agent in Chicago not later than October 17 a ticket for the return journey by the same route as traveled to Chicago may be purchased at one third the one way fare. Tickets may be purchased between October 5 and 11 in the territory covered by this arrangement. The return journey must be completed within thirty days from date of sale of going ticket. It is important to note that the return trip must be made by the same route as used in traveling to Chicago, and that the certificate must be viséd at headquarters during the meeting and return ticket purchased not later than October 17.

Reduction of fares does not apply to Pullman fares or extra fares charged for passage on certain trains. Ticket agents will supply detailed information with regard to dates of sale, rates, routes, etc.

In the western and southwestern states, including the Pacific coast states and the western provinces of Canada, the railways have authorized the sale of round-trip tickets to Chicago at very low rates on account of A Century of Progress and have not entered into the convention fare certificate plan as outlined above for the eastern states. Ticket agents should be consulted with regard to these special rates.

Also, the railways in the eastern and south-eastern states and eastern provinces of Canada are offering round trip tickets at reduced rates on account of A Century of Progress. Particulars as to these special rates may be obtained from ticket agents.

ANNUAL MEETING

The annual meeting of the College will convene in the ballroom of the Stevens Hotel at 2 o'clock Thursday afternoon. Reports on the activities of the College will be presented by the officers and chairmen of the standing committees, followed by the election of officers.

HEADQUARTERS—HOTELS

General headquarters for the Clinical Congress will be established at the Stevens Hotel, located on Michigan Avenue between Seventh and Eighth Streets. This hotel affords unusual facilities for all activities of the Congress, as will be remembered by those who attended the Congress in

Chicago in 1929. The grand ballroom on the second floor with other large rooms on the third floor and the exhibition hall have been reserved for the exclusive use of the Congress. All of the evening sessions, the hospital conference on Monday the annual meeting the cancer and fracture symposia will be held in the grand ballroom. The registration and information bureau together with the bulletin boards on which will be displayed the daily clinical program will be established in the exhibition hall together with the Technical Exhibition.

Chicago has many fine large hotels, several within walking distance of the headquarters hotel. A list of the hotels recommended by the Committee on Arrangements is presented herewith. While Chicago's hotel facilities are very great and there should be no difficulty in securing first-class hotel accommodations, it is necessary for those who expect to attend the Clinical Congress to reserve their hotel accommodations immediately as A Century of Progress Exposition is attracting to Chicago a very large number of visitors.

ADVANCE REGISTRATION

The hospitals of Chicago afford accommodations for a large number of visiting surgeons, but to insure against overcrowding the attendance will be limited to a number that can be comfortably accommodated at the clinics—the limit of attendance being based upon the results of a survey of the amphitheaters, operating rooms, and laboratories of the hospitals and medical schools to determine their capacity for visitors.

CHICAGO HOTELS AND THEIR RATES

| | Minimum Rates With Bath | |
|---|----------------------------|--------|
| | Single | Double |
| Ambassador North State Street at Goethe | \$3 50 | \$6 00 |
| Auditorium, Michigan Blvd. and Congress | 3 50 | 6 00 |
| Belden Stratford, 2300 Lincoln Park West | 4 00 | 6 00 |
| Belmont, Sheridan Road at Belmont | 4 00 | 5 00 |
| Bismarck, Randolph at LaSalle St. | 3 50 | 5 00 |
| Blackstone, Michigan Blvd. and 7th St. | 3 00 | 5 00 |
| Brewster, 120 West Madison St. | 3 50 | 5 50 |
| Congress, Michigan Blvd. and Congress | 4 00 | 6 00 |
| Drake, Lake Shore Drive and Michigan | 3 00 | 5 00 |
| Edgewater Beach, 5300 Sheridan Road | 4 00 | 6 00 |
| Great Northern, Jackson and Dearborn | 3 50 | 4 00 |
| Knickerbocker, 163 East Walton | 3 00 | 5 00 |
| LaSalle, LaSalle at Madison St. | 2 50 | 4 00 |
| Morrison, 79 West Madison St. | 3 00 | 4 50 |
| Palmer House, State and Monroe Sts. | 3 50 | 6 00 |
| Pearson, 120 East Pearson St. | 3 00 | 5 00 |
| Stevens, Michigan Blvd. bet. 7th and 8th. | 3 50 | 5 00 |

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics and insures against overcrowding as the number of tickets issued for each clinic will be limited to the capacity of the room in which that clinic will be given.

A registration fee of \$5 00 is required of each surgeon attending the annual Clinical Congress such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card must be presented in order to secure clinic tickets and admission to the evening meetings.

SYMPOSIUM CANCER IS CURABLE

Wednesday 2 30 P.M. —Ballroom, Stevens Hotel

ROBERT B. GREENOUGH, M.D., Boston, Chairman, Committee on the Treatment of Malignant Diseases, Presiding.

General Subject of Curability of Cancer FRANKLIN H. MARTIN M.D., Director-General

Cancer as an Arrestable Disease CHARLES A. DUKES, M.D. Oakland, Calif.

General Cases of Five year Cures IRVIN ABELL, M.D., Louisville Ky. FRANK K. BOLAND M.D., Atlanta, Ga. JOHN JOSEPH GALLIGAN M.D., Salt Lake City Utah CHEVALIER JACKSON M.D. Philadelphia ALBON R. KILGORE, M.D. San Francisco CHARLES C. LUND M.D. Boston DAMON B. PFEIFFER, M.D. Philadelphia, EUGENE H. POOL, M.D., and JOHN A. VIETOR, M.D., New York H. BECKWITH WHITE HOUSE, M.S. F.R.C.S. Birmingham, England.

Cancer of the Breast MALVERN B. CLOFTON M.D. St. Louis, E. STARR JUDS, M.D., Rochester Minn. JAMES MONROE MARON M.D., Birmingham Ala. JOHN T. MOORE, M.D. Houston, Tex. RICHARD R. SMITH, M.D. Grand Rapids, Mich.

Cancer of the Pelvic Organs and Breast. BROOKE M. ANSPACH, M.D. Philadelphia HARRY S. CROSWELL M.D., St. Louis, WILLIAM P. HEALY M.D. New York CHARLES C. NORRIS, M.D. Philadelphia.

Cancer of the Pelvic Organs JAMES C. MARSON M.D. Rochester Minn. CARL HENRY DAVIS M.D. Milwaukee.

Cancer of the Cervix GEORGE GRILLHORN M.D. St. Louis.

Cancer of the Kidney Bladder and Prostate HERMAN L. KRETSCHEMER, M.D. Chicago.

Cancer of the Rectum ROBERT C. COFFEY M.D., Portland, Ore.

Cancer of the Thyroid Gland and Large Intestine JOHN DEJ. FLEMINGTON M.D. Rochester Minn.

Cancer of the Thyroid MARTIN B. TINKER M.D. Ithaca, N.Y.

Malignant Bone Tumors WILLIAM B. COLEY M.D. New York

CONFERENCES—SYMPOSIA—PUBLIC MEETINGS

SYMPOSIUM TREATMENT OF FRACTURES

Tuesday 2 30 P.M.—Ballroom, Stevens Hotel

- CHARLES L. SCHROEDER, M.D., Boston Accomplishments and Ideals of the Regional Fracture Committees.
 ROBERT H. KENNEDY, M.D., New York Transportation of Early Long Bone Fractures Co-ordination of the Activities of the Committee on the Treatment of Fractures of the American College of Surgeons with (a) the Red Cross, (b) the railroad association, (c) ambulances and morticians.
 WILLIAM J. EITZ, Jr., M.D., Bethlehem, Pa. The After-Care in Preventing Disabilities Following Fractures.
 INDORE COMA, M.D., New Orleans Clinical Examination versus X-ray Examination in Fractures During Childhood.
 FREDERICK J. TEEL, M.D., Montreal Dislocation of the Radiocarpal Joint.
 ARTHUR STEINBUCH, M.D., Iowa City, Iowa Fracture Disabilities of the Wrist and Fingers.

COMMUNITY HEALTH MEETING

Wednesday 8:00 P.M.—Chicago Steel arm

- At 7:30—Organ prelude
 Chorus of 500 nurses in uniform.
 Addresses of Welcome. PHILIP H. KREUTCHER, M.D., Chairman of Committee on Arrangements, and ARTHUR A. HANSEN, M.D., President of Chicago Medical Society.
 WILLIAM D. HAGGARD, M.D., Nashville, President, American College of Surgeons, Presiding.
 Invocation. DR. LOUIS L. MANN, Rabbi, Chicago Sinai Congregation.
 The American College of Surgeons—Its Message for You. FRANKLIN H. MARTIN, M.D., Chicago, Director General.
 Adding Years to Your Life and Life to Your Years. CHARLES H. MAYO, M.D., Rochester, Minn.
 Cancer—It is a Curable Disease. BURTON J. LEE, M.D., New York.
 A Century of Progress in Scientific Medicine. GEORGE W. CHASE, M.D., Cleveland.
 The Care of the Prospective Mother. C. JEFF MILLER, M.D., New Orleans.
 Why Are You Nervous? ALFRED W. ADSON, M.D., Rochester, Minn.
 Saving Your Eyesight. JOHN O. MCKEYMOULDS, M.D., Dallas, Texas.
 Doctors, Hospitals, and Patients. ROBERT JOLLY HOUSTON, Texas.

SYMPOSIUM ON UROLOGICAL SURGERY

Friday 11:00 A.M.—Ballroom, Stevens Hotel

- JOSIE R. CAGLE, M.D., St. Louis. Transurethral Surgery.
 FRANK HIRSHMAN, M.D., San Francisco. The Pathogenesis of Hydrocephalus.
 JOSEPH F. MCCARTHY, M.D., New York. The Prostatic Gland—Its Place in General Medicine: Newer Conception of Diagnosis and Therapy.
 Discussion. HIRSHMAN L. KAPTEINOVICH, M.D., and CHARLES MORGAN MCKENNA, M.D., Chicago.

INDUSTRIAL MEDICINE, TRAUMATIC SURGERY

Friday 2 00 P.M.—Ballroom, Stevens Hotel

- FREDERICK A. BENTLEY, M.D., Chairman, Board on Industrial Medicine and Traumatic Surgery Presiding.
 Will Industrial Medicine and Traumatic Surgery Have a Place in the National Industrial Recovery Act?
 FRANKLIN H. MARTIN, M.D., Chicago.
 A Three Years' Survey of Medicine and Surgery in Industry; Legislative Enactments and Other Indemnity Problems. M. N. NEWCOMB, M.D., Chicago.
 Preventive Health Measures in Industry as Revealed in a Three Years Survey. E. W. WILLIAMSON, M.D., Chicago.
 Injuries of the Chest. CARL A. HEDSTROM, M.D., Chicago.
 Acute Injuries of the Abdomen. WILLIAM O'NEILL SHERMAN, M.D., Pittsburgh.
 Trauma of the Spinal Column. FRED H. ALMER, M.D., New York.
 Cerebral Injuries. CHARLES BAGLEY, JR., M.D., Baltimore.
 Rehabilitation of the Injured. FREDERICK J. GARDNER, M.D., Milwaukee.
 Co-operation of the Chief Surgeons with the Standardization of Medical Services in Industry. JOHN R. ALABRY, M.D., Omaha, President of the Association.

A CENTURY OF PROGRESS

Sunday 7 00 P.M.—Court of the Hall of Science

Arcturus Ceremony

7 30-8 15 P.M.

- ROBERT JOLLY HOUSTON, TEXAS, Master of Ceremonies.
 Music—St. Luke's Hospital Doctors Alumni Association Orchestra.
 Chorus—1000 Nurses in Uniform, Chicago Hospital Association.

8 15 10:00 P.M.

- J. BENTLEY SQUIER, M.D., New York, President, American College of Surgeons, Presiding.
 Address of Welcome. RUTUS DAWKIN, Chicago, President, A Century of Progress.
 Address of Welcome. WILLIAM ALLAN PURDY, M.D., Chicago. Member, Executive Committee, and Chairman, Section on Medical Sciences, A Century of Progress.
 Response to Address of Welcome and Appreciation of What A Century of Progress Has Done for Scientific Medicine. GEORGE W. CHASE, M.D., Cleveland, Chairman, Board of Regents.
 The American College of Surgeons and the Clinical Congress. Introduction of Representatives from Other Countries. FRANKLIN H. MARTIN, M.D., Chicago, Director General, American College of Surgeons.
 Greetings from Canada, Central America, South America, British Isles, Europe, and Australasia.
 Surgery in the Past One Hundred Years. WILLIAM D. HAGGARD, M.D., Nashville, Tenn.
 Surgery in the Next One Hundred Years. CHARLES H. MAYO, M.D., Rochester, Minn.
 If You Were Sick—One Hundred Years Ago and Today. ROBERT JOLLY HOUSTON, TEXAS.

PROGRAMS FOR EVENING MEETINGS

BALLROOM OF THE STEVENS HOTEL AT 8 15

Presidential Meeting, Monday, October 9

Address of Welcome. PHILIP H. KREUSCHER, M.D. Chairman of Committee on Arrangements.
 Introduction of Foreign Guests. FRANKLIN H. MARTIN, M.D., Director General.
 Address of Retiring President. The Hippocratic Code and the New Deal. J. BENTLEY SQUIER, M.D.
 New York.
 Inauguration of Officers.
 Inaugural Address. Surgery the Queen of the Arts. WILLIAM D. HAGGARD, M.D. Nashville, Tenn.
 John B. Murphy Oration in Surgery. The Story of a Master Surgeon. LOYAL DAVIS, M.D. Chicago.

Tuesday October 10

The Common Syndrome of Rupture, Dislocation and Elongation of the Biceps Brachii: an Analysis of Fifty Cases. EDGAR L. GILCREST, M.D. San Francisco.
 Discussion. KELLOGG SPEED, M.D. and PAUL B. MAGNUSON, M.D. Chicago.
 Fracture Oration. The Treatment of Fractures Involving Joints. W. E. GALLIE, M.D. F.R.C.S. (Eng.) Toronto, Ontario.
 Technique and Results of the Operative Lengthening of the Femur. VITTORIO PUTTI, Bologna, Italy.
 Discussion. WILLIAM R. CUBBINS, M.D. and BEVERIDGE H. MOORE, M.D. Chicago.

Wednesday October 11

Sympathectomy in Children. DAVID EDWIN ROBERTSON, M.D., Toronto, Ontario.
 Discussion. EDWIN W. RYERSON, M.D., Chicago.
 Symposium on Vascular Diseases.
 Thrombo-Angiitis Obliterans (Buerger's Disease). GEORGE E. BROWN, M.D. Rochester, Minn.
 Ligation of Large Arteries. MONT ROOGERS REED, M.D. Cincinnati.
 Discussion. R. W. MCNEALY, M.D. and GEZA DE TAKATY, M.D., Chicago.
 Mastopatia and Chronic Mastitis. H. BECKWITH WHITEHOUSE, M.S. F.R.C.S. Birmingham, England.
 Discussion. MAX CUTLER, M.D., Chicago.

Thursday October 12

Symposium on Diseases of the Thyroid.
 Hyperthyroidism and Associated Diseases. GEORGE W. CRILE, M.D. Cleveland.
 The Treatment of Exophthalmos. HOWARD C. NAFFIGER, M.D., San Francisco.
 Tumors of the Parathyroid Glands. EDWARD D. CHURCHILL, M.D. Boston.
 Discussion. HARRY M. RICHTER, M.D. and LESTER DRAGSTEDT, M.D. Chicago.

Convocation—Friday October 13

Invocation.
 Conferring of Fellowships.
 Conferring of Honorary Fellowships.
 Presidential Address. Surgeon of the Wilderness—Ephraim McDowell. WILLIAM D. HAGGARD, M.D. Nashville, Tenn.
 Fellowship Address. ROBERT MAYNARD HUTCHINS, A.M. LL.D. President University of Chicago.

SECTION ON OTOLARYNGOLOGY

Tuesday 8 15 P M—North Ballroom, Stevens Hotel

Otolaryngology's Present Day Economics. BURT R. SHURLEY, M.D. Detroit, Michigan.
 Discussion opened by ROBERT SONNENSCHNIG, M.D. and AUSTIN A. HAYDEN, M.D. Chicago.

SECTION ON OPHTHALMOLOGY

Thursday 8 15 P M—North Ballroom, Stevens Hotel

Removal of Orbital Tumors. W. L. BENEDICT, M.D. Rochester, Minn.
 Discussion opened by RICHARD GAMBLE, M.D. Chicago.
 Surgical Correction of Ocular Disfigurement. MEYER WIENER, M.D. St. Louis.
 Discussion opened by SAMUEL J. MEYER, M.D. Chicago.

ANNUAL HOSPITAL STANDARDIZATION CONFERENCE

Monday 10:00-12:30—Ballroom Stevens Hotel

J. BENTLEY SQUIER, M.D. New York, President, American College of Surgeons, presiding.
Address of Welcome J. BENTLEY SQUIER, M.D. New York.

The 933 Hospital Standardization Survey and Announcement of List of Approved Hospitals FRANKLIN H. MARTIN, M.D. Chicago Director General, American College of Surgeons

The Hospital Standardization Movement in Relation to the Practice of Internal Medicine WALTER L. BILK RING, M.D. Des Moines, Iowa.

Opportunities of the Surgeon and the Hospital in Promoting Community Interest in the Proper Care of the Sick and Injured. BERT W. CALDWELL, M.D. Chicago.

Preparation for a Surgical Career WILLIAM D. HAGGARD, M.D. Nashville, Tenn.

The Modern Philosophy of Medicine REY ALPHONSE M. SCHWITZALLA S.J. Ph.D. St. Louis.

A Century of Progress ERNEST J. CAREY, M.D. Milwaukee Wis.

The Next Century of Progress in Medicine GEORGE W. CRILL, M.D. Cleveland.

Motion picture (sound) Good Hospital Care

Monday 2:00-5:00—Ballroom Stevens Hotel

ROBERT B. GRIFFITH, M.D., Boston, presiding.
Round Table Conference Medical and Hospital Economics: Maintaining as low hospital charges as are consistent with good care of the patient—from the standpoint of

The Surgeon ALEXANDER W. BLAIR, M.D. Detroit, Mich.

The Internist S. MARK WINTER, M.D. Minneapolis, Minn.

The Specialist AUSTIN A. HAYDEN, M.D. Chicago.

The Radiologist H. B. PODGASKY, M.D. Milwaukee, Wis.

The Pathologist J. J. MOORE, M.D. Chicago.

The Hospital Management PAUL H. FORTNER, Chicago.

Hospital Economics as Applied to the Small Hospital CLINTON F. SMITH, Waterloo, Iowa.

Prepayment Plans for Hospital Service WILLIAM H. WALSH, M.D. Chicago.

The Alameda Plan CHARLES A. DUKES, M.D. Oakland, Calif.

Tuesday 8:30-12:30—Ballroom Stevens Hotel

ALEXANDER R. MCKINNON, M.D. Edmonton, Alberta, presiding

The Application of Hospital Standardization in the Small Hospital MAURICE T. LEWIS, Princeton Ind.

The Hospital Annual Report. CHARLES E. REND, M.D. Minneapolis, Minn.

Convalescent Care for the Patient G. HARVEY AGERS, M.D. Toronto, Ontario.

The Organization, Management and Functioning of the Department of Anesthesia in a 300 Bed Hospital BEVERLY LARSEN, M.D. Regina, Saskatchewan

The Organization, Management, and Functioning of the Clinical Laboratory ROBERT L. GLENN, M.D. Oakland, Calif.

Clinical and Clinico-Pathological Conferences OLIVER W. LOHR, M.D., Saginaw Mich.

Tuesday 2:00-5:00—St. Luke's Hospital

Demonstration in hospital administration conducted by CHARLES A. WOODRILL, Manager St. Luke's Hospital. Admitting and discharging patients. Care of emergencies in hospitals. Nursing administration and service. Business methods.

Wednesday 9:30-12:30—Ballroom, Stevens Hotel

Joint Conference—American College of Surgeons and Association of Record Librarians of North America. R. C. BUEKEL, M.D., Madison, Wis. presiding.

Plan and Scope of the Record Department. MARY M. NEWCOMB, Pittsburgh, Pa.

A Survey of Cancer Records in Hospitals. PERCILLA WIEBE, New York.

The Importance of Accurate and Complete Records in Fracture Cases FRANK D. DICKSON, M.D. Kansas City, Mo.

The Importance of Accurate and Complete Obstetrical Records JOHN R. FRASER, M.D. Montreal, Quebec.
Round table conference—problems associated with the obtaining of good clinical records in hospitals.

Wednesday 2:00-5:00—Albert Merritt Billings Hospital

Demonstration in hospital administration conducted by JOHN C. DICKINSON, Superintendent, University of Chicago Clinics. Organization and management of the clinical record department. Organization and functioning of the social service department. Organization and management of the obstetrical department. Operating room management and procedure. Tour of observation including the Chicago Lying In Hospital.

Thursday 9:30-12:30—Ballroom, Stevens Hotel

Round table conference—administrative, medical, nursing, economic, and social problems affecting hospitals. Conducted by ROBERT JOLLY HENSTON, Texas, and R. C. BUEKEL, M.D. Madison, Wis.

Thursday 2:00-5:00—Local Hospitals

Demonstrations of hospital administration in approved Chicago hospitals.

PRELIMINARY CLINICAL PROGRAM

GENERAL SURGERY GYNECOLOGY, OBSTETRICS ORTHOPEDICS UROLOGY, PROCTOLOGY SURGICAL PATHOLOGY ETC

PASSAVANT MEMORIAL HOSPITAL—NORTH
WESTERN UNIVERSITY MEDICAL SCHOOL

Tuesday

- LEANDER W. RIBA—9. The use of the electro-urethrotome in urethral strictures.
ARTHUR H. CURTIS and GEORGE H. GARDNER—9. Gynecological operations.
JOHN A. WOLFE—9. Cholecystitis, carcinoma of colon.
JACOB R. BUCHBINDER—9. Thyroid surgery.
JOHN S. COULTER and staff—10. Hyperpyrexia by physical agents in the treatment of arthritis.
RUDOLPH W. HOLMES and staff—1. Symposium on cardiac diseases in their obstetric associations. CHESTER C. DOHERTY. Etiology and pathology. JAMES E. FITZGERALD. Medical aspects and treatment. JAMES H. BLOOMFIELD. Obstetrical aspects and treatment.
JOHN A. WOLFE—1. Dry clinic. Alimentation of the critically ill patient by jejunal feedings.
LOYAL DAVIS, HALE HAYEN and DAVID A. CLEVELAND—2. Presentation and review of neurosurgical cases.

Wednesday

- HARRY M. RICHTER—9. Thyroid surgery.
LOYAL DAVIS—9. Neurological surgery.
SUMNER L. KOCH and MICHAEL L. MASON—9. Nerve and tendon surgery of the hand.
JAMES T. CARE—10. Roentgenology.
PHILIP H. KREUSCHER—1. Hip joint surgery.
ALLEN B. KAMAVEL, SUMNER L. KOCH and M. L. MASON—2. Review of twenty years of surgery of the hand.
PAUL B. MAGNUSON—1. Ununited fracture of the neck of the femur. Bone graft in the spine.
RUDOLPH W. HOLMES and staff—2. Symposium on toxemias of late pregnancy renal and hepatic. JAMES P. SIKOROS. Etiology and pathology. CHESTER C. DOHERTY. Symptoms and laboratory investigation. DAVID S. HILLIS. Medical (expectant) treatment. RUDOLPH W. HOLMES. Obstetrical treatment.
LEANDER W. RIBA—2. Dry clinic. Prostatic resection.
EMIL D. W. HAUSER—2. Orthopedic surgery.

Thursday

- ARTHUR H. CURTIS and GEORGE H. GARDNER—9. Gynecological operations.
JOHN A. WOLFE—9. Cholecystitis carcinoma of the breast.
JACOB R. BUCHBINDER—9. Abdominal surgery.
JOHN S. COULTER and staff—10. Physical therapy in the after-treatment of hand injuries.
PHILIP H. KREUSCHER—1. Shoulder and knee-joint derangement.
RUDOLPH W. HOLMES and staff—2. Symposium on obstetrical hemorrhages. RUDOLPH W. HOLMES. Abatto placentae. DAVID S. HILLIS. Placenta previa. MAGNUS P. URMES. Postpartum hemorrhages. THEODORE W. BLOCH. Treatment of sequential anemias.
CHARLES A. ELLIOTT, WALTER H. NADLER, PAUL STARR, M. HERBERT BARKER, HOWARD B. CARROLL and HOWARD L. ALT—1. Symposium on hepatic disease.

Friday

- HARRY M. RICHTER—9. Gastric surgery.
LOYAL DAVIS—9. Neurologic surgery.

- SUMNER L. KOCH and MICHAEL L. MASON—9. Irradiation ulcers of the hand. Dupuytren's contracture.
JAMES T. CARE—10. Roentgenology.
JOHN S. COULTER and staff—10. Physical therapy in arthritis.
PAUL B. MAGNUSON—2. Demonstration of principles for overcoming deformity in ununited fractures before operation, bone grafts for ununited fractures.
RUDOLPH W. HOLMES and staff—2. Symposium on hyperemesis gravidarum. CHESTER C. DOHERTY. Etiology and pathology. MAGNUS P. URMES. Symptoms and clinical course. JAMES H. BLOOMFIELD. Treatment.
Staff—2. Symposium on gastric ulcer. HARRY M. RICHTER. Surgical aspects. ANDREW C. IVY. G. B. FAULEY and J. R. ORNDORFF. Results of the use of gastric mucin in peptic ulcer experimentally produced. SAMUEL J. FOGELSON and A. J. ATKINSON. Use of gastric mucin in treatment of gastric ulcer.

ST LUKE'S HOSPITAL

Monday

- H. E. MOCK, A. REID MORROW and CHARLES SHANNON—1. General surgical operations.
E. OLDBERG—2. Neurological surgery.

Tuesday

- H. O. JONES, WILLIAM P. CARLISLE, M. J. KILEY, E. A. EDWARDS and JOHN BREWER—9. Gynecological operations. Early human embryo demonstration.
CARL HEDBLUM and WILLARD VAN HAEDEL—9. Thoracic surgery.
H. E. MOCK—2. Reconstructive surgery.
L. L. MCARTHUR and S. W. MCARTHUR—2. General surgery.

Wednesday

- L. E. SCHMIDT—9. Urological clinic.
E. W. RYERSON and F. A. CHANDLER—9. Orthopedic operations.
S. C. PLUMMER—9. General surgery.
H. E. JONES and T. L. HANSEN—9. General surgery.
E. W. RYERSON, R. O. RITTER and H. O. SOTHELD—2. Orthopedic operations.
FRANK E. DAVID, C. J. DEBERG and G. V. PONTIUS—2. Rectal surgery.

Thursday

- G. DETAKATS—9. Surgery in juvenile diabetes. Ambulatory vein ligation of varicose veins.
H. E. MOCK—9. General surgery.
HARRY CULVER—9. Urological clinic.
H. E. MOCK, A. REID MORROW and CHARLES SHANNON—2. Skull fractures.
W. R. CURRY—2. General surgery.
H. B. THOMAS and F. W. HARK—1. Orthopedic clinic.

Friday

- W. F. LYON—9. Dislocations of the shoulder with fracture of the greater trochanter.
H. PORTS and F. W. MERRIFIELD—9. Oral surgery operative.
E. W. RYERSON, F. A. CHANDLER and R. O. RITTER—2. Orthopedic clinic.

PRESBYTERIAN HOSPITAL AND RUSH
MEDICAL COLLEGE

Tuesday

- A. D. BEVAN—*g.* Surgery of the breast.
 V. C. DAVIS—*g.* Carcinoma of sigmoid.
 H. L. KRITCHINGER—*g.* Kidney surgery.
 R. H. HENNER—*g.* Transurethral electro resection of prostate gland.
 KELLOGG SPENCER—*g.* Tumors of chest wall, demonstration of cases, lantern slides.
 A. H. MONTGOMERY—*11* Abdominal surgery in children.
 A. VANDERGRADT—*2* Neurosurgical operation.

Wednesday

- A. D. BEVAN—*g.* Hernia and undescended testicle.
 F. B. MOOREHEAD—*g.* Plastic surgery of mouth and face.
 C. B. DAVIS—*g.* Tumors of the large intestine.
 H. L. KRITCHINGER—*g.* Surgery of the bladder.
 N. S. HEARN—*g.* Vaginal surgery.
 DR. GATEN COB—*g.* Carcinoma of the stomach, follow-up clinic.
 L. M. MILLER—*g.* Thyroid surgery.
 H. A. OBERHEIMER—*g.* Surgery in diabetic patients.
 E. R. MC CARTHY—*1* Strangulated hernia in infants.
 W. J. POTTS—*2* Fracture problems.

Thursday

- A. D. BEVAN—*g.* Surgery of gall bladder and bile tract.
 H. L. KRITCHINGER—*g.* Transurethral resection of the prostate.
 F. B. MOOREHEAD—*g.* Cleft palate surgery; operative treatment of ankylosis of jaw.
 DR. GATEN COB—*g.* Gastric resection for ulcer.
 R. H. HENNER—*g.* Diverticula of urinary bladder.
 R. H. HENNER and C. W. APPERLANCE—*g.* Unusual urinary anomalies.
 Staff—*g.* Dry clinic. E. D. ALLEN, endometriosis; C. P. BAUER, dystocia; ALBION KANTER, recognition of early carcinoma of uterus.
 G. L. McWORTER—*10*. Fracture of the greater tuberosity of the humerus.
 A. VANDERGRADT—*g.* Spinal cord injuries.

Friday

- Staff—*g.* Dry clinic. A. D. BEVAN. Present status of anastomosis. H. L. KRITCHINGER. Genito-urinary surgery. R. C. BROWN. Treatment of massive hemorrhage in gastric ulcer. V. C. DAVIS. Significance of polyps of large bowel. E. M. MILLER. Method of intravenous injection over long period of time. R. H. HENNER. Fibrosis of bladder neck. F. H. STRAUSS. Obstructive jaundice. G. L. McWORTER. Reconstruction of common bile duct, cases. M. L. LORING. Granuloma inguinale, cases. S. E. LAWTON. Cholecystenterostomy indications.
 E. J. BECKENBACH—*2*. Orthopedic clinic.

ST FRANCIS HOSPITAL

Thursday

- E. FOWLER—*2*. Painful shoulder.
 H. REYNOLDS—*2*. Indications for duodenal and jejunal drainage and feeding.
 T. E. COOLEY—*2*. Value of hyperventilation, prevention and treatment of thrombophlebitis.
 B. FILLIS—*2*. Mechanical aids in urology.
 H. F. MAAS—*2*. Uses and improved methods of administration of parenteral fluids.
 I. H. CANNON—*2*. Management of gastric, biliary and jejunal fistula.

MERCY HOSPITAL

Tuesday

- E. M. BROWN—*g.* Malignancy of the colon.
 J. E. KELLY—*g.* Chronic intestinal fistula; extensive ventral hernia.
 GEORGE GRUTTER—*g.* Pyloric obstruction.
 J. D. CLARKE—*g.* Fractures and dislocations of the cervical spine.
 C. J. LARSEN—*g.* Rupture of the spleen simulating acute appendicitis.

Wednesday

- M. F. McGUIRE—*g.* Biliary tract surgery.
 C. F. SAWYER—*g.* Acute pancreatitis, perforating gastric and duodenal ulcers.
 C. L. MARTIN—*g.* Anal fistulectomies in cases with pulmonary tuberculosis.
 L. E. GARRISON—*g.* Carcinoma of the colon; carcinoma of the breast.
 HERBERT L. LARSEN—*g.* Surgical anatomy of vesical orifice and urethral obstructions; treatment of bladder tumors.

Thursday

- L. D. MOOREHEAD—*g.* Toxic goiters, differential diagnosis of cases of dysthyroidism and hyperthyroidism with indication for operation and management.
 W. J. PICKETT—*g.* Technical considerations in posterior gastro-enterostomy.
 F. E. PIERCE—*g.* Fracture cases.
 F. M. DICKMAN and F. C. VALLEY—*g.* Gastro-intestinal clinic.

Friday

- HENRY SCHMIDT and HERBERT E. SCHMIDT—*g.* Gynecological clinic; surgery and radiation therapy.
 JOSEPH LAKE—*g.* Carcinoma of the genito-urinary tract.
 A. M. VAUGHN—*g.* Cystic hygroma in an infant.

CHILDREN'S MEMORIAL HOSPITAL

Monday

- FREDMONT A. CHANDLER, FREDERICK SEIDLER and CHARLES N. PEARCE—*2*. Osteochondroma of fibula, radio-ulnar synostosis, spastic paralysis, Thomas's disease; hip fusion; knee fusion; spine fusion, flat feet; congenital dislocation of hip; synovectomy in arthritis; scoliosis.

Tuesday

- FREDMONT A. CHANDLER, CHARLES N. PEARCE and FREDERICK SEIDLER—*g.* Spine fusion, hip fusion; knee fusion; section of obturator nerves in spastic paralysis, congenital dislocation of hip.
 FREDERICK B. MOOREHEAD—*2*. Cleft lip and cleft palate operations; demonstration of operated cases of ankylosis of the jaw.

Wednesday

- JOHN GRAHAM—*g.* General surgical operations and demonstrations.

Thursday

- HERMAN L. KRITCHINGER—*g.* Urological operations.
 C. A. ALDRICH—*g.* Clinical consideration of urological conditions.
 W. G. HIRSH—*g.* Pathological demonstration of urological cases.

Friday

- ALBERT H. MONTGOMERY and J. J. McNEIL—*g.* Appendicitis in children; lymphangioma of the omentum; sacral chordoma; fractures of the skull and extremities in children.
 STANLEY LAWTON—*g.* Undescended testicle.

COOK COUNTY HOSPITAL

Monday

SUMNER L. KOCH—2 General surgery
F. H. FALLS—2 Gynecology
E. J. BERKEHEISER—2 Orthopedics
WILLIAM R. CUBBINS—2 General surgery
MARSHALL DAVISON—2 General surgery

Tuesday

SUMNER L. KOCH—9 Diagnostic clinic.
R. W. MCNEALY—9 General surgery
AARON KANTER—9 Gynecology
GEORGE DAVIS—9 General surgery
A. H. MONTGOMERY—9 General surgery
A. H. CONLEY—9 Orthopedics
CAREY CULBERTSON—9 Gynecology
J. O'DONOGHUE—9 General surgery
HARRY CULVER—9 Urology
H. JACKSON—9 General surgery
MARCUS HOBART—9 Orthopedics
VERNON C. DAVID—9 Diagnostic clinic.
DR. GATEWOOD—9 General surgery
J. P. GREENHILL—2 Gynecology
RALPH B. BETTMAN—2 Surgery in tuberculosis.
E. WARZELWICK—2 General surgery

Wednesday

CHANNING BARRETT—9 Gynecology
HARRY CULVER—9 Urology
V. L. SCHLAGER—9 General surgery
GEORGE APPELBACH—9 General surgery
J. G. FROST—9 General surgery
R. C. SULLIVAN—9 General surgery
L. L. VERSEK—9 Urology
FRANK JURKA—9 General surgery
R. VAUGHAN—9 General surgery
PHILIP H. KREUSCHER—9 Orthopedics
CHARLES M. MCKENNA—9 Urology
H. ROLNICK—2 Urology
HARRY CULVER—2 Urology
GEORGE DAVIS—2 General surgery
J. R. BUCHENBINDER—2 General surgery
DAVID HILLIS—2 Obstetrical operations
SUMNER L. KOCH—2 General surgery

Thursday

PHILIP H. KREUSCHER—9 Orthopedics
CHANNING BARRETT—9 Gynecology
GEORGE DAVIS—9 General surgery
R. W. MCNEALY—9 General surgery
MARCUS HOBART—9 Orthopedics
D. HORN—9 Gynecology
KARL A. MEYER—9 General surgery
E. W. FRIEDMAN—9 Gynecology
A. H. MONTGOMERY—9 General surgery
MAX THORAK—9 General surgery
A. H. CONLEY—9 Orthopedics
D. H. LEVINTHAL—9 Orthopedics
JOHN HANCOCK—2 General surgery
F. H. FALLS—2 Gynecology
E. J. BERKEHEISER—2 Orthopedics
RALPH BETTMAN—2 General thoracic surgery
WILLIAM R. CUBBINS—2 General surgery

Friday

GEORGE APPELBACH—9 General surgery
AARON KANTER—9 Gynecology
R. C. SULLIVAN—9 General surgery
CAREY CULBERTSON—9 Gynecology

VERNON C. DAVID—9 General surgery
MARCUS HOBART—9 Orthopedics
F. G. DYAS—9 General surgery
J. O'DONOGHUE—9 General surgery
H. JACKSON—9 General surgery
DR. GATEWOOD—9 General surgery
JOHN HANCOCK—2 General surgery
J. R. BUCHENBINDER—2 General surgery
MARSHALL DAVISON—2 General surgery
E. WARZELWICK—2 General surgery
SUMNER L. KOCH—2 General surgery

INSTITUTE OF TRAUMATIC SURGERY

(St. Luke's Hospital)

Wednesday

GEORGE G. DAVIS—9 Rupture of the urethra
JOHN D. ELLIS—9 15 Routine examination of injured back.
FREDMONT A. CHANDLER—9 30 Separation of isthmus of lower lumbar vertebrae.
WILLIAM R. CUBBINS—9 45 Old dislocation of shoulder
HARRY E. MOCK—10 Demonstration of cases of multiple injury
LEROY P. KUHN—10 15 Ruptured spleen and other abdominal cases.
E. W. RYERSON—10 30 Spondylolisthesis in relation to injuries.
GEORGE L. APPELBACH—10 45 Cotton's fracture.
R. W. MCNEALY—11 Immediate repair of injured blood vessels.
E. C. HOLMELAND—11 15 Compression fractures of the spine.
PHILIP H. KREUSCHER—11 30 Knee joint injuries.
HOLLIS E. POTTER—11 45 Some X-ray aspects of silicosis.
C. R. G. FORBES—12 Reduction of fractures under local anesthesia together with ambulatory treatment, moving picture demonstration.
LEROY THOMPSON—1 30 Intra-ocular foreign bodies.
STONEY WALKER, JR.—1 45 Lacerated wounds of the eyeball.
PAUL B. MAGNUSON—2 Anomalies of the spine.
A. M. HARVEY—2 15 Demonstration of rehabilitated cases.
EDMUND B. FOWLER—2 30 Troublesome shoulders.
KEILLOGG SPEED—2 45 Injuries to internal semilunar cartilage.
HERMAN L. KRETSCHMER—3 Management of traumatized kidney.
JAMES A. VALENTINE—3 15 Treatment of ruptured biceps tendon.
FRED M. MILLER—3 30 The injured hand.
STONEY W. HOPKINS—3 45 New apparatus to increase efficiency of Thomas splint.
FRED W. SLOBE—4 Bilateral renal carbuncle with perinephritic abscess.
HART E. FISHER—4 15 Electric burns in children.
CLARENCE W. HOPKINS—4 30 Modern treatment of compression fractures of the spine.
ARNO B. LUCHARDT—4 45 Choice of anesthetic in surgical shock.

MOTHER CABRINI MEMORIAL HOSPITAL

Tuesday

EUGENE J. CHESBROW—9 General surgical clinic.

Wednesday

EUGENE J. CHESBROW—9 General surgical clinic.

Thursday

EUGENE J. CHESBROW—9 General surgical clinic.

MICHAEL REESE HOSPITAL

Tuesday

ALFRED A. STRAUSS, SIGMUND F. STRAUSS, JAMES PATEDJL and ROBERT A. CRAWFORD. Stomach resections for gastric and duodenal ulcer; common duct duodenal anastomosis and gastro-enterostomy for chronic obstructive jaundice.

GEORGE L. DAVENPORT and RALPH BETTMAN. Gall bladder surgery; surgery of the common duct.

D. C. STRAUSS. Thyroid surgery.

E. FRIED. General surgery; surgery of the gall bladder.

BERNARD PORTER. Thyroid surgery; surgery of the rectum.

HARRY RUCHTER. Thyroid surgery; gall-bladder surgery.

MAX CUTLER. Surgery of the breast.

GUSTAV KOLINSCHER. Diathermy of bladder tumor; nephrectomy for tuberculosis.

IRVING KOLL. Electrical resection of prostate; nephrothotomy.

DANIEL H. LEVINTHAL. Internal derangements of the knee joint; removal of semi-lunar cartilage; synovectomy for chronic arthritis; bone lengthening operation.

JULIUS L. LACHNER. Abdominal hysterectomy; interposition operation; rectovaginal fistula.

JOSEPH L. BAKER and RALPH REIS. Complete perineal laceration; ovarian tumor and pelvic inflammation.

Wednesday

D. C. STRAUSS. Thyroid surgery; gall-bladder surgery.

RALPH BETTMAN. Surgery of the chest.

GEORGE L. DAVENPORT. General surgery.

ALFRED A. STRAUSS, SIGMUND F. STRAUSS and ROBERT A. CRAWFORD. Sectional colectomy for ulcerative colitis and pyroplasty for congenital pyloric stenosis.

BER and PORTER. General surgery and surgery of the colon.

MORRIS L. PARKER. General surgery.

JAMES PATEDJL. General surgery.

JOSEPH EISENSTADT. Undescended testis; suprapubic prostatectomy.

HARRY RUCHTER. Electric resection of prostate; pyelotomy for stones.

PHIL LEWIN and SIDNEY SEDENAU. Orthopedic clinic, shoulder, elbow, hand, hip, pelvis.

L. E. FRANKENTHAL, SR. and L. E. FRANKENTHAL, JR. Gynecological operations.

W. H. RUBINOFF. Obstetrical and gynecological clinic, demonstration of forceps, version and complete suture epiotomy.

IRVING STEIN and M. L. LEVINTHAL. Obstetrical clinic, low cervical cesarean under local anesthesia.

Thursday

RALPH BETTMAN. Surgery of gall bladder and common duct.

ALFRED A. STRAUSS, SIGMUND F. STRAUSS and ROBERT A. CRAWFORD. Surgical diathermy for carcinoma of the rectum, resections for carcinoma of the stomach.

D. C. STRAUSS. Surgery of colon, small intestine; thyroid.

GEORGE L. DAVENPORT. Surgery of the common duct.

BERNARD PORTER. General surgery.

SIGMUND F. STRAUSS. General surgery.

HARRY RUCHTER. Surgery of the thyroid.

E. FRIED. Surgery of the gall bladder and common duct.

ALFRED E. JONES. Nephrectomy for tuberculous kidney; suprapubic prostatectomy.

IRVING SHAPIRO. Diathermy of bladder tumor; nephrectomy for tumor of kidney.

DANIEL H. LEVINTHAL. Surgery of the spine, fusion operation for scoliosis and for tuberculosis.

CHARLES M. JACOBS. Orthopedic clinic.

JULIUS E. LACHNER. Gynecological operations.

JOSEPH L. BAKER and RALPH REIS. Prolapse vaginal hysterectomy; fibroids, occiput posterior.

Friday

ALFRED A. STRAUSS, SIGMUND F. STRAUSS, JAMES PATEDJL and ROBERT A. CRAWFORD. Subtotal gastrectomy for gastroduodenal ulcer; resection of colon for carcinoma.

D. C. STRAUSS. Surgery of the thyroid and general surgery.

GEORGE L. DAVENPORT and RALPH BETTMAN. Gall-bladder surgery and surgery of the common duct.

RALPH BETTMAN. Thoracic surgery.

BERNARD PORTER. Surgery of the colon and rectum.

MORRIS L. PARKER. General surgery.

MAX CUTLER. Surgery of the breast; use of radiotherapy in carcinoma.

FREDERICK LIEBENTHAL. Suprapubic prostatectomy; ureterotomy.

J. S. GROVE. Undescended testes.

PHIL LEWIN and SIDNEY SEDENAU. Orthopedic clinic, back, hip, knee foot, shoulder; demonstration of strabismus cases.

L. E. FRANKENTHAL, SR. and L. E. FRANKENTHAL, JR. Gynecological clinic.

W. H. RUBINOFF. Gynecological clinic.

IRVING STEIN and M. L. LEVINTHAL. Gynecological clinic.

ST MARY OF NAZARETH HOSPITAL

Monday

A. S. SAMPOLENSKI—2. General surgical clinic.

E. H. WARMER and P. F. CRAWFORD—2. Inguinal hernia clinic.

THEO LARKOWSKI—2. Demonstration of blood transfusion.

Tuesday

GEORGE MUELLER—9. General surgical clinic.

S. R. PRZYBYLO—9. Spinal puncture and anesthesia—indications, contra-indications, advantages, disadvantages, demonstrations.

C. C. BUCKENELL—2. Varicocele operations and demonstrations.

M. J. BARNOWSKI and B. PRZYBYLO—2. Gynec. clinic, operations and demonstration of cases.

Wednesday

T. Z. YELLOWHEAD—9. Gynecology and abdominal surgery.

W. A. KUTLER—9. Emergency and general surgery.

F. DEBROCK—9. Surgical clinic.

THOMAS PLANT—9. General surgery.

A. A. TREIDA—9. General surgery.

FRANK TENNAR—9. General surgery.

JOHN TENNAR—9. General surgery.

CHRISTIE CHALLENGER—9. X-ray demonstration.

MIRIAM KUTZ—2. General surgery.

F. A. MACKOWIAK—2. General surgery.

M. E. UENAKKE—2. Obstetrical clinic; low cesarean section.

Thursday

LEO CRAJA—9. Orthopedic clinic; maggot treatment of osteomyelitis.

E. MACDONALD—9. Abdominal surgery.

H. H. HILL—9. Demonstration of pathological specimens.

A. V. PARTIELLO—2. Aseptic resection of the bowel, demonstration of cases, moving picture exhibition.

M. E. UENAKKE—2. Surgical anatomy of the perineum, lantern slide demonstration.

Friday

JOSEPH WELFELD—9. Urological clinic.

GEORGE MUELLER—9. General surgery.

CHRISTIE CHALLENGER—9. X-ray demonstration.

H. H. HILL—9. Demonstration of pathological specimens.

ROBERT R. FLANNERY—2. Gall bladder surgery.

LEO P. KOKARIEWICZ—2. Cesarean section, indications, contra-indications, demonstrations.

MOUNT SINAI HOSPITAL

Tuesday

- V. L. SCHRAGER and J. T. GAULT—9. Hernia, breast and biliary surgery
 ISRAEL DAVIDSOHN—11 Pathological demonstration.
 M. I. KAPLAN—11 X ray diagnosis and therapy
 GUSTAV KOLINSCHER and HARRY ROLNICK—3 Genito-urinary surgery

Wednesday

- HARRY M. RICHTER, J. M. MORA and D. WILLIS—9. Gastric and thyroid surgery
 ISRAEL DAVIDSOHN—11 Pathological demonstration.
 M. I. KAPLAN—11 X ray diagnosis and therapy
 ALFRED A. STRAUSS, S. STRAUSS, E. GREENE, I. E. BISHKOW and B. SATRE—3 Gastro-intestinal surgery
 RALPH B. BEITMAN and L. HANDELMAN—3 Intrathoracic surgery operations.

Thursday

- AARON KANTER, A. F. LAKE, E. SCHWED and H. L. KLAWE—9 Gynecological operations.
 ISRAEL DAVIDSOHN—11 Pathological demonstration.
 M. I. KAPLAN—11 X ray diagnosis and therapy
 CHARLES JACOBS and LEO MILLER—3 Orthopedic operations.

Friday

- HARRY ROLNICK—9. Genito-urinary surgery
 ISRAEL DAVIDSOHN—11 Pathological demonstration.
 M. I. KAPLAN—11 X ray diagnosis and therapy

Dry Clinics—Daily 9 and 3

- ISRAEL DAVIDSOHN Value of biopsy in surgery
 HENRY BUKHAUM Toxemias of pregnancy
 GUSTAV KOLINSCHER—Electrosurgery in cancer therapy
 AARON KANTER Chorio-epithelioma following a vesicular mole functional uterine hemorrhage.
 HARRY ROLNICK Bladder tumors.
 A. F. LAKE Treatment of birth injury early diagnosis of uterine cancer
 DAVID A. WILLIS Relation of adrenals to thyrotoxicosis, morbidity in operation for acute appendicitis in relation to the question of drainage demonstration of a universal traction splint as used in a small hospital.
 EMIL L. ALBOW Fractures of the maxilla and mandible.
 M. REBER GUTMAN Recent advances in the treatment of malignant diseases about the head and neck, endoscopic clinic.
 Staff. Symposium Cancer of the lung. I. M. TRACE, medical aspect, JACOB LEFSCHUTZ, bronchoscopic aspect, ISRAEL DAVIDSOHN pathological aspect M. I. KAPLAN X ray aspect.
 MAURICE LEWISON Medical appraisal of surgical risks.
 JOSEPH T. GAULT Present status of the treatment of varicose veins.
 EARLE I. GREENE Intestinal obstruction.
 J. M. MORA Inflammatory lesions of the thyroid.
 I. E. BISHKOW Present status of blood transfusion.
 CHARLES JACOBS Supracondylar fractures of femur a modified treatment of correction of hallux valgus.
 EARL HERRON A case of acute septic epiphysitis with interesting X ray changes in the head of the femur bridge cast in treatment of supracondylar fractures of the elbow joint.
 LEO MILLER Effect of radio-opaque substances on the synovial membrane of the knee joint rheumatoid arthritis.

RAVENSWOOD HOSPITAL

Tuesday

- G. W. GREEN—9. Gall-bladder surgery mortality and morbidity
 C. A. BUSWELL—9 30. Survey of cancer study organization in a private hospital.
 D. B. POND—10 Orthopedic surgery
 E. W. MUELLER and J. J. MOORE—10 30. Carcinoma of testis.
 M. FIELD—11 Diagnosis and management of sterility
 L. C. FRENCH and D. L. JENKINSON—11 30. Gastric syphilis.

Wednesday

- G. DE TARNOWSKY and J. J. MOORE—9 Carcinoma of colon, modified Kraske operation.
 J. IRELAND—9 30. Fractures of the elbow
 R. F. WEISSERKNER—10. Emotions as etiological factors in hyperthyroidism.
 C. H. LOCKWOOD—10 15. Headaches.
 H. P. SAUNDERS—11 Blood transfusion
 L. E. DAY—11 15. Obstetrics.
 J. F. OATES—11 30. Spinal anesthesia.

Thursday

- C. C. RENTRO—9. Obstetrical anesthesia.
 W. F. GROSVENOR—9 15. Cesarean section.
 A. C. HAMMERT—9 30. Mental disturbances of diabetes.
 A. V. BERGQUIST—9 45. Indigestion.
 F. N. BERRY—10 Granulosa cell carcinoma of ovary
 R. E. DYER—10 30. Surgical technique.
 P. J. SARMA—11 Paramedian abdominal incision.
 F. R. VON NAIKOWITZ—11 15. Mortality in appendicitis.
 E. B. WILLIAMS—11 30. Pott's disease fracture of spine.

JACKSON PARK HOSPITAL

Monday

- F. L. BARBOUR—3 Dry clinic Symposium on treatment of pulmonary tuberculosis, surgical and medical.

Tuesday

- T. H. KELLEY—9. General surgical clinic.
 ARNIE BAMBERGER—10 General surgical clinic.
 C. C. CLARK—11 General surgical clinic.
 S. B. MACLEON—2. Fracture clinic.

Wednesday

- ARNIE BAMBERGER—9. General surgical clinic.
 H. HOYT COX—10. General surgical clinic.
 S. W. MARCHMONT ROBINSON—2. Dry clinic Hand infections as related to industrial surgery
 H. F. SPERLING—3. Mortality of appendicitis.

Thursday

- ARNIE BAMBERGER—9. General surgical clinic.
 T. H. KELLEY—10. General surgical clinic.
 G. MARCHMONT ROBINSON—11 Injection treatment of hemorrhoids.
 E. ALLEN PARSONS—12. Postoperative treatment of ruptured appendix with peritonitis.
 R. T. FARLEY—1. Chorio-epithelioma, pseudo Addison's disease vulvula.
 J. J. MOORE—2. Gross surgical pathology

Friday

- A. F. HENNING—9. General surgical clinic.
 GEORGE M. LUCAS—10 Gynecological surgery
 C. C. CLARK—11 General surgical clinic.

CHICAGO MEMORIAL HOSPITAL

Tuesday

ARTHUR H. CONLEY and FRED M. MILLER—*g.* Orthopedic and industrial injury clinic.
 JAMES E. FITZGERALD—*g.* Obstetrical clinic.
 JOHN P. O'NEIL, J. WILLIAM PARKER and DORRIS F. RUDOLPH—*g.* Urological clinic.

Wednesday

CHARLES E. KANTLER, LAWRENCE L. IRDMAN and M. L. WRIGHT—*g.* General surgical clinic.
 FRANK WRIGHT—*g.* Colloidal state of the blood in post operative pneumonia.
 GEORGE M. LANDAU—*g.* Phrenico exeresis and treatment of unilateral tuberculosis.
 CASPER M. EUSTICE—*g.* Oral and plastic surgery

Thursday

C. R. G. FORRESTER—*g.* Fracture clinic.
 CHARLES J. DEUBCK, SR.—*g.* Proctology
 HARRY L. MEYERS—*g.* Gynecological clinic.
 WILLIAM L. BROWN—*g.* Radium clinic.

Friday

PETER S. CLARK, LEO M. ZIMMERMAN, and ROBERT A. MELERDY—*g.* General surgical clinic.
 JULIA C. STRAWN and PAUL M. CLIVER—*g.* Gynecological clinic

COLUMBUS HOSPITAL

Tuesday

DANIEL A. ORTE, C. O. LINDSTROM and M. L. HANDAN—*g.* General surgery
 DANIEL A. ORTE—*g.* Indications and contra-indications for spinal anesthesia.
 CHAMBERLAIN BARRETT—*g.* Gynecological operations.
 MIRAS JOAKIMIDES—*g.* Collapse therapy in pulmonary tuberculosis
 M. J. SEIFERT—*g.* Surgical treatment of ulcer of the stomach.
 MIRAS JOAKIMIDES—*g.* Surgery of the chest.

Wednesday

CHAMBERLAIN BARRETT—*g.* Gynecological clinic.
 G. N. BLECHER and M. B. BURKS—*g.* Emergency surgery in industrial injuries.

Thursday

MIRAS JOAKIMIDES—*g.* Surgical treatment of abscess of lung.
 F. MUELLER and F. MUELLER, JR.—*g.* Transplantation of bone
 WILLIAM GIEL and T. L. CHERKOWITZ—*g.* Urological clinic.
 G. N. BLECHER and M. B. BURKS—*g.* Emergency surgery in industrial injuries.

Friday

DANIEL A. ORTE, C. O. LINDSTROM and M. L. HANDAN—*g.* General surgery
 M. J. SEIFERT—*g.* General surgery

U. S. MARINE HOSPITAL

Wednesday

O. E. NADRAU—*g.* General surgical clinic

Friday

O. E. NADRAU—*g.* General surgical clinic.

WESLEY MEMORIAL HOSPITAL

Monday

R. W. MCNEALY—*g.* Gall-bladder cholecystectomy; inguinal herniotomy
 E. I. GREER—*g.* Hyperthyroidism in children.

Tuesday

P. B. MAGNUSON, W. A. HENDRICKS and H. E. E. BARNARD—*g.* Synovectomy; arthroplasty of knee and jaw cholecystectomy
 C. B. REED and G. C. RICHARDSON—*g.* Obstetrical clinic, moving picture demonstration of breech delivery; perineorrhaphy and forceps delivery; demonstration of external measurements of intra-uterine child.
 W. B. SEBERT—*g.* Cesarean section.

Wednesday

GEORGE H. GARDNER—*g.* Classic repair of cystocele.
 R. W. MCNEALY—*g.* Breast amputation; gastro-enterostomy
 PHILIP H. KREFFCHER—*g.* Joint surgery

Thursday

P. B. MAGNUSON, W. A. HENDRICKS and H. E. E. BARNARD—*g.* Bone graft of lower spine; bone graft of sacro-iliac joint; extracapsular fusion of hip cholecystectomy
 GUY VAN ALSTYCK—*g.* Ostetia tuberculosis multiplex cystica (Joungling)
 VICTOR D. LESPERANCE—*g.* Urological clinic.
 M. T. GOLDSIEDE—*g.* Gynecological clinic.

Friday

R. W. MCNEALY—*g.* Ventral and inguinal herniotomy
 EDWARD PERRY—*g.* Urological surgery

MUNICIPAL TUBERCULOSIS SANTARIUM

Tuesday

CLEMENT L. MARIN—*g.* Perianal tuberculosis.
 MIRAS JOAKIMIDES—*g.* Thoracoplasty; phrenic neurectomy
 HENRY C. SWEANY—*g.* Pathological conference, demonstration of pathological specimens.

Wednesday

DORRIS F. RUDOLPH—*g.* Nephrectomy for tuberculosis of kidney; operative surgery for tuberculosis of the genitourinary tract.
 FRANK FRIEDMEL and FRANK SMYKAL—*g.* Artificial pneumothorax.
 FREDERICK TUCK, ALLAN J. HURBY and K. J. HENDERICHSEN—*g.* Diagnostic clinic.

Thursday

MIRAS JOAKIMIDES and RICHARD DAVENPORT—*g.* Thoracoplasty; pneumothorax; phrenic neurectomy
 K. J. HENDERICHSEN—*g.* Artificial pneumothorax

Friday

ALLAN J. HURBY and K. J. HENDERICHSEN—*g.* Surgical conference.

OUTPATIENT PNEUMOTHORAX CLINIC

3049 Washington Boulevard

MIRAS JOAKIMIDES, E. L. QUINN, ERIC BUNYA, CLARA JACOBSON and GEORGE THEOLOGOS—*g.* and *g.* daily
 Artificial pneumothorax on ambulatory patients.

WOMEN AND CHILDREN'S HOSPITAL

Monday

FRANCIS FORD—2 X ray therapy in malignancies.

Tuesday

BERTHA VAN HOOKER—9. Gynecological operations.

JOSEPHINE MCCOLLUM and BERTHA VAN HOOKER—10 Demonstrations of morphine and scopolamine anesthesia in surgery.

O. ZILBERY—12 Demonstrations of electrocoagulation therapy.

Wednesday

PEARLE STETLER—9. General surgical operations.

WALBURGA RACIN and CLARA OCTER—2. Obstetrical cases, management under scopolamine anesthesia.

FRANCIS FORD—2 X ray demonstrations.

PEARLE STETLER—2 Surgical diagnosis of appendicitis in children.

Thursday

ALICE CONKLIN—9. General surgery.

Staff—9. Fracture cases.

MARIE OSTMEYER—10. Urological clinic.

ANIELLA GRYTTAS—11. Carcinoma of the pelvis.

ELOISE PARKSON—2 Endocrine therapy in gynecology sterility operations.

Friday

MARY E. WILLIAMS—9. Gynecological operations.

CONSTANCE O'BRIEN—11 General surgical operations.

MARY SPYACK and FLORENCE HARR—2 Obstetrical.

CHARLES FORD—2 X ray and diathermy therapy.

RESEARCH AND EDUCATIONAL HOSPITAL

Monday

H. B. THOMAS—1 Orthopedic surgery

Tuesday

CARL A. HEDBLUM and WILLARD VAN HAZEL—9. Thoracic and general surgery

L. S. SCHULTZ—9. Oral surgery

Wednesday

ERIC OLIVERO—9. Neurological surgery

R. B. MALCOLM—9. Neurological surgery

H. B. THOMAS—1 Orthopedic surgery

F. H. FALLS—2 Obstetrical and gynecological clinic

Thursday

CHARLES B. PURSTOW—9. General surgery

C. M. MCKENNA—10. Urological clinic cystoscopes.

WILLARD VAN HAZEL—2. Thoracic surgery

Friday

CARL A. HEDBLUM and WILLARD VAN HAZEL—9. Thoracic and general surgery

F. H. FALLS—2. Obstetrical and gynecological clinic.

WASHINGTON BOULEVARD HOSPITAL

Tuesday

PAUL C. FOX—9. Gynecological clinic.

Wednesday

A. R. METZ—9. General surgical clinic, presentation of unusual fractures.

Thursday

J. J. O'CONNOR—9. Hydronephrosis, etiology and treatment, case reports, X-rays and operative results suprapubic prostatectomy and transurethral resection of prostate comparatively. Indications and results.

CHICAGO LYING-IN HOSPITAL

Staff: FRED L. ADAMS, J. B. DELEE, WILLIAM J. DIERCK, MARION M. EDWARD DAVIS, FRANK E. WHITACRE, MANUEL SPIEGEL and H. C. HESSELBERG.

Monday

Staff—2. Obstetrical operations, motion picture demonstration.

Tuesday

Staff—9. Obstetrical and gynecological operations.

Wednesday

Staff—9. Obstetrical and gynecological operations.

Staff—2. Obstetrical clinic, motion picture demonstration.

Thursday

Staff—9. Obstetrical and gynecological operations.

Staff—2. Obstetrical and gynecological dry clinic, motion picture demonstration.

Friday

Staff—9. Obstetrical and gynecological operations.

Staff—2. Obstetrical and gynecological dry clinic motion picture demonstration.

AMERICAN HOSPITAL

Tuesday

R. B. MALCOLM—9. Surgical clinic, tumors of the neck.

MAX THORNE and PHILIP THORNE—9. Surgical clinic carcinoma of the rectum.

W. B. GERHARD—9. General surgical clinic.

FRANK E. SOMMER—2. Radium treatment of carcinoma of the mouth and tongue.

SOLOMON GREENSPAN and FREDERICK HOWE—2. Management of placenta previa.

Wednesday

MAX THORNE and PHILIP THORNE—9. Surgical clinic.

HOMER E. TURNER and S. GREENSPAN—9. Casualty surgical clinic.

DAVID H. PARDOIL and LEON REILLY—9. Urological clinic.

FRANK E. SOMMER—2. Radiological clinic, carcinomas of the breast and female genitalia.

Thursday

BENJAMIN GOLDWING and JOHN F. PICK—9. Indications and technique for surgery of the chest.

FRANK E. SOMMER—2. Radiological clinic, indications and contraindications to radium treatment.

ILLINOIS CENTRAL HOSPITAL

Tuesday

HUGH N. MACKESSON—9. General surgery

PHILIP H. KARDERCHER—9. Orthopedics.

Wednesday

CHARLES PFYFFER—9. General surgery

BREVIDGE MOORE—9. Orthopedics.

Thursday

S. CLEMENTY HOGAN—9. General surgery

VICTOR LEROUX—9. Genito-urinary surgery

Friday

WILLIAM T. HARRIS—9. General surgery

JAMES GILL—9. Neurologic surgery

JOHN J. GILL—9. Obstetrics.

CHARLES GUY and A. H. BADGER—9. Pathological conference.

HOSPITAL OF ST ANTHONY DE PADUA

Monday

THOMAS DRYER—3 Demonstrations in surgical pathology

Tuesday

LAWRENCE RYAN—9 General surgery
J J SERRAFA—9 General surgery
O J JIRKA—9 Urology
L S TICHN—2 X ray demonstration.

Wednesday

R C CUPLER—9 General surgery
JOSEPH ZABOKRATSKY—9 General surgery
F W SLOWE— Fracture clinic.
M A WISNIAOFF—3 Obstetrics.

Thursday

FRANK J JIRKA—9 Abdominal operations.
F B OLIVETTEL and R C DRYER—9 Thyroid surgery and general surgical clinic
O J JIRKA—9 Urology
L S TICHN—2 X ray demonstration.

Friday

S E DONLON—9 General surgery
A A BONA—9 General surgery
M A WISNIAOFF—9 Obstetrics
F J E LEBMAN—9 General surgery
WILLIAM BRADLEY—9 General surgery

GRANT HOSPITAL

Tuesday

ANDRE L STAPLER—9 General surgery
F H FALLS—9 Gynecology
E FISCHMANN—9 Vaginal hysterectomy
A G FALLS—9 General surgery
RODOLFO ABELLO—9 General surgery
L HILSH—9 Urology

Wednesday

E. SAIDLER—9 Midlateral resection.
A G ZIMMERMAN—9 General surgery

Thursday

B H ORNDORF—9 Electrosurgery
W A STUBER—9 General surgery
ANDRE L STAPLER—3 General surgery

Friday

SYLVAN COOMBS—9 General surgery
E W FISCHMANN—9 Pus tubes.
A G ZIMMERMAN—9 General surgery

EDGEWATER HOSPITAL

Wednesday—3

N LOWRY Electrosurgery in the treatment of carcinoma of the rectum.
LOREN WILDER. Bone transplants.
L PILLOT Allergic manifestations in arthritis.
R ELMER Biliary surgery
M A BLUMFELDER. Bone sarcoma.
M. MAYER. Traumatic rupture of the spleen.
N ZETTEL Intestinal obstruction.
M. KERN and LOREN WILDER Surgical and nonsurgical thyroid.
A. F. LANE. Colposcopy
D SCHLAFER. Prostatic resection.
T PARKER. Fractures of the femur

HOLY CROSS HOSPITAL

Tuesday

J FRANCIS RUDEK—9. Gynecological operations. cholecystectomy high spinal anesthesia.
E. R. CROWDER—9. Some practical considerations regarding the Graham test.
JOHN F DYBALSKI—10. Hysterectomy spinal anesthesia.
VICTOR TORCZYNSKI—1. Appendectomy

Wednesday

DONALD MONACO—9. Thyroidectomy—lecture on averted anesthesia.
A R. McCRAID—10. Hernia operation.
PAUL LAWLER—11. Low cervical cesarean section.

Thursday

STEPHEN BIEBS—9. Gynecological operations
MICHAEL STRIKOL—10. Cholecystectomy
F F FRADIER—11. Panhysterectomy
C. H. McKENNA—11. Cholecystectomy

Friday

M J BARDACHOWSKI—9. Thyroidectomy hysterectomy
RICHARD ROCKE—10. Herniorrhaphy
ALEXANDER JAVORS—11. Appendectomy

LUTHERAN DEACONESS HOSPITAL

Tuesday

GEORGE H. SCHROEDER, JOHN KOUTSKY H. C. WALLACE and G H MAMMEN—9. General surgical clinic.

Wednesday

GEORGE H. SCHROEDER, JOHN KOUTSKY H. C. WALLACE, G H. MAMMEN, R. G. WILLY and G O. SOLER—9 Clinical demonstrations.

Thursday

GEORGE H. SCHROEDER, JOHN KOUTSKY H. C. WALLACE and G H. MAMMEN—9. General surgical clinic

Friday

GEORGE H. SCHROEDER, JOHN KOUTSKY H. C. WALLACE, G H. MAMMEN, R. G. WILLY and G O. SOLER—9 Clinical demonstrations.

ST JOSEPH HOSPITAL

Monday

HUGH McKENNA—2. Review of traumatic surgery with special reference to fractures.

Tuesday

FRANKLIN B. McCARTY—9. Surgical anatomy pathology and surgical treatment of diseases of the gall bladder.
RALPH A. KORDENAT—2. Breast tumors.

Wednesday

HUGH McKENNA—9. Abdominal surgery surgery of the large intestine.
WALTER W. VOGOT—9. Puerperal sepsis.
THOMAS J. O'DONOHUE—2. Obstetrical and gynecological operations.

Thursday

WILLIAM H. G. LOGAN—9. Cleft palate and cleft lip operations.
RALPH C. KORDENAT—2. Gall-bladder surgery

Friday

L. WADZ MARTIN—9. Obstetrical clinic.

AUGUSTANA HOSPITAL

Tuesday

N. M. PERCY and O. E. NADEAU—*g.* Goiter and general surgical clinic.

Wednesday

A. T. LUNDGREN and EARL GARRIDE—*g.* General surgery
J. W. NUTZUM—*g.* General surgical clinic.
R. J. ODEN—*g.* General surgical clinic.

Thursday

N. M. PERCY and O. E. NADEAU—*g.* Goiter and general surgical clinic.

Friday

A. T. LUNDGREN and EARL GARRIDE—*g.* General surgery
J. W. NUTZUM—*g.* General surgical clinic.
R. J. ODEN—*g.* General surgical clinic.

EVANSTON HOSPITAL

Tuesday

JAMES T. CASE—*g.* X-ray diagnosis and therapy
WILLIAM R. PARKES—*g.* Thyroid clinic.
MARCUS H. HORANT—*g.* General surgical clinic.
DWIGHT F. CLARK—*3.* Recent advances in the treatment of common fractures.
MARCUS H. HORANT—*3.* Fracture clinic.

Wednesday

WILLIAM C. DUNFORTH—*g.* Gynecological operations.
CHARLES E. GALLOWAY—*g.* Gynecological operations.
JEROME R. HEAD—*g.* Thoracic surgery.
FREDERICK CHRISTOPHER—*3.* Demonstration of surgical cases.
ROBERT C. LOWMEGAN—*3.* Demonstration of orthopedic cases.

Thursday

WILLIAM C. DUNFORTH—*g.* Gynecological operations.
JOHN L. PORTER—*g.* Orthopedic operations.
WILLIAM C. DUNFORTH—*3.* Obstetrical clinic.
CHARLES E. GALLOWAY—*3.* Schiller test for the early diagnosis of carcinoma of the cervix.

Friday

FREDERICK CHRISTOPHER—*g.* General surgical clinic.
FRANCIS D. GUNCK—*g.* Demonstration of surgical pathology.
CHARLES E. POPE—*g.* Proctological clinic.
J. EVERETT SAWYER—*3.* Urological clinic.

OAK PARK HOSPITAL

Tuesday

JOHN W. TOPE—*g.* General surgery.
GORDON SWANSON—*g.* Orthopedic clinic.
ARTHUR CONILLA—*g.* Management of fractures of the femur.

Wednesday

RALPH SULLIVAN—*g.* General surgical clinic, treatment of peptic ulcer.
CHARLES FOX—*g.* Gynecological operations.
CARL UTHOFF—*g.* Operative cystoscopy.

Thursday

LOUIS RIVER—*g.* General surgery.
ADOLPH KRAFT—*g.* General surgery.
CARL UTHOFF—*g.* Genito-urinary operations.

Friday

JOHN W. TOPE—*g.* General surgery.
MEREDITH MURRAY—*g.* Gynecological operations.

SOUTH SHORE HOSPITAL

Tuesday

AXEL WERELIUS—*g.* Gastric surgery.
GEORGE G. O'BRIEN—*3.* General surgery.
CLARENCE S. DUNKER and AXEL WERELIUS—*3.* Symposium on gastric and duodenal ulcer.

Wednesday

HUGH MACKECHENT—*g.* Surgery of the colon.
FRANK G. MURPHY—*3.* Orthopedic clinic.
H. WILLIAM ELOHAMMER, GUY S. VAN ALSTYNE and PAUL R. CANNON—*3.* Symposium on intussusception.

Thursday

LOUIS D. SMITH—*g.* Genito-urinary surgery.
CLARA JACOBSON—*3.* Lung collapse procedures.
C. C. MANER—*4.* Cardiac risk in surgery.

Friday

E. A. LUTTON—*g.* Gynecological clinic.
ANDREW DAHLBERG and WILLIAM HANRAHAN—*3.* Operative obstetrics.
H. R. COLVER—*3.* Industrial surgery.
WALTER FINCHER—*3.* Foot problems.

ST BERNARD'S HOSPITAL

Monday

W. G. EPSTEIN—*3.* General surgery.

Tuesday

W. J. MULHOLLAND—*g.* General surgery.
H. HOFMANN—*g.* General surgery.
G. M. CUSHING—*3.* General surgery.
L. B. DOWDLE—*3.* Genito-urinary surgery.

Wednesday

B. C. CUSHWAY and R. J. MAIER—*g.* Roentgenological demonstration of anomalies of spine.
J. B. HARKERLIN—*g.* General surgery.
W. S. HECTOR—*g.* General surgery.
J. A. PARKER—*3.* General surgery.
S. L. GOVERALE and S. S. MARKIEWICZ—*3.* Gastro-intestinal operations.

Thursday

J. T. MEYER—*g.* Thyroid surgery.
F. M. PRIFER—*g.* Genito-urinary surgery.
W. P. GUNCK—*g.* Gynecological operations.
D. A. VLOETMAN—*3.* Gynecological operations.
C. C. GUY—*3.* Demonstration of unusual specimens.

Friday

A. E. McCRAE—*g.* General surgery.
E. A. RACH and F. J. STUCKER—*g.* Operative obstetrical problems.

EVANGELICAL DEACONESS HOSPITAL

Tuesday

EDWARD HEACOCK—*g.* General surgery.

Wednesday

PAUL MOHR—*g.* General surgery.

Thursday

A. J. SCHOENBERG—*g.* Pelvic surgery.

Friday

JOHN PEARL—*g.* Abdominal surgery—spinal anesthesia.

JOHN B MURPHY HOSPITAL

Monday

JOSEPH KERRICK and R. J. MURPHY—2. Rectal treatment of appendical and other pelvic abscesses.

Tuesday

H. E. DAVIS—10. Studies of epiphyseal growth disturbances.

Wednesday

M. J. PURCELL—9. Emergency surgery
O. H. SCHULZ—10. Observations on treatment of pneumonia.

Thursday

F. O. BOWEN—9. Treatment of puerperal infections.
H. R. KERRY and S. J. MARK—9. General surgery

Friday

A. C. GARY—9. Diagnosis and treatment of skull fractures
H. R. KERRY and S. J. MARK—9. Pre-operative treatment in abdominal cases.

GARFIELD PARK COMMUNITY HOSPITAL

Tuesday

Staff—9. Symposium on surgery of the stomach with special reference to peptic ulcer. SAMUEL G. PLICE Diagnosis and medical management. HAROLD N. WAIT. Diagnosis from roentgen ray standpoint. PAUL G. SCHMIDT. Pathology. JOHN R. HARGREAVE. Surgery.

LESLIE F. MACDONALD—1. General surgery

Wednesday

CLAUDE WELOT and JOHN J. PYLOCK—9. Medical and surgical aspects of gall bladder disease. hysterectomy

Thursday

JOHN M. BERGER and FRANK CHAUVEY—9. Gall-bladder disease with special reference to myocardial changes.

Friday

CLARENCE SARKIS—9. Displastic stratus of bacteria from renal lesions, experimental production of lesions with spirochetes (spirochaeta pallida)

VICTOR J. O'CONNOR—9. Tuberculosis of kidney with review of cases; hydronephrosis, plastic repair of nephropexy

LITTLE COMPANY OF MARY HOSPITAL

Monday

W. D. SEARLE—8. Management of eclamptic patients.

Tuesday

L. L. CHAFFIN—9. Management of fractures about the elbow

J. E. LAINE—10. Treatment of carcinoma of the bladder

Wednesday

E. D. HUNTINGTON—9. Gastro-intestinal surgery complications.

Thursday

L. L. CHAFFIN—9. Management of compound fractures.
W. A. MALONE—1. Radium treatment of carcinoma of the cervix.

Friday

A. W. WOODS—9. Gynecological repair operations.
E. D. HUNTINGTON—9. Intestinal obstruction.

POST-GRADUATE HOSPITAL

Monday

B. C. CUNNINGHAM—2. X ray diagnosis.

Tuesday

H. SOLOWAY—10. Urological clinic.

EMIL REIS—10. Gynecological operations.

D. SCHLAFER—2. Intra-urethral prostatectomy, roentgen picture demonstration.

Wednesday

J. C. BOODER—10. Rectal operations.

LEO ZIMMERMAN—2. Phlebilia.

Thursday

H. L. MAYERS—10. Gynecological operations.

R. A. LINDENBARK—11. Gynecological clinic with colposcopic demonstration.

Friday

EMIL REIS—10. Gynecological operations

ILLINOIS MASONIC HOSPITAL

Tuesday

E. W. WHITE—9. Prostatic and renal surgery

O. C. RYAN—9:30. Surgery of the kidney

CLARENCE SARKIS—11. Tumors of the testicle.

Wednesday

GILBERT FITZ PATRICK—9. Obstetrical problems.

CHARLES H. PARKER—9:30. Inguinal hernia, cryptorchidism.

CARL F. STERNHOFF—11. Medical phases of thyroid disease.

HUGH N. MACKECHENE—11. Surgery of the thyroid.

Friday

J. ROWEN HARRY—9. Medical phases of gall-bladder disease.

CLYTON K. THOMSON—9. Gall-bladder surgery

JOHN F. DAVIS—9:30. Surgery of the colon.

WALTER R. FISCHER—11. Orthopedic problems of the foot

WEST SUBURBAN HOSPITAL

Monday

HARRY J. DOOLEY—2. Urological clinic.

Tuesday

WILLIAM J. POTTS—9. The healing of fractures

OSCAR B. FUNKHOUSER—9. Gall-bladder surgery

THOMAS L. MOTTER—9. General surgery

JAMES H. SKELLS—9. Gynecological clinic.

Wednesday

JOSEPH L. NORTON—9. General surgery

FREDERICK H. FALLS—9. Gynecological clinic.

Thursday

CHARLES E. HUMPHREY—9. General surgery

WARD E. POTTER—9. Thyroid clinic.

LOUIS FAULKNER—9. Interesting obstetrical conditions

PAUL C. FOX—9. Gynecological clinic.

EDOUARD C. PIETTE—9. Pathological demonstration.

HOMER HUMPHREY—2. Urological clinic.

Friday

HARRY J. STEWART—9. General surgical clinic.

ST ANNE'S HOSPITAL

Tuesday

T. E. MEANY—10. Orthopedic clinic.
J. L. KNAPP—11. General surgery
J. B. HARMON—2. X ray demonstration.

Wednesday

G. F. THOMPSON—9. Stomach and intestinal surgery
J. W. MCCONNELL—10. Gynecology
J. J. GEARIN—11. General surgery

Thursday

H. J. DOOLEY—9. Urological clinic.
E. P. VAUGHAN—9. Gall-bladder surgery
E. P. GRAMER—10. Treatment of head injuries.
J. L. FLEMING—11. Pathological obstetrics.

Friday

B. W. MACK—9. General surgery
Staff—10. Clinical meeting.
D. F. HAYES—11. General surgery
L. R. HILL—2. Pathological demonstration.

ALBERT MERRITT BILLINGS HOSPITAL

Staff—9, daily. General surgical operations and clinical demonstrations.

WILLIAM ADAMS. Demonstrations in thoracic surgery
EDMUND ANDREWS. Gall-bladder surgery
ALEXANDER BRUNSCHWIG. Management of malignant tumors and experimental bone tumors.
E. L. COMPER, C. H. HATCHER and DR. KEYES. Operations and demonstrations in orthopedic surgery
LESTER R. DRAGSTEDT. Surgery of the stomach and colon.
C. B. HUGGINS and H. E. HAYMOND. Operations and demonstrations in genito-urinary surgery
HILGER P. JENKINS. Abdominal surgery
D. B. FREEMAN. Bone surgery operations and demonstrations.

ALEXIAN BROTHERS HOSPITAL

Tuesday

MALCOLM L. HARRIS, AUGUST ZIMMERMAN, ROBERT FLANNERY and GEORGE L. APPELBACH—9. General surgery
A. WOCHINSKI and EDWARD WHITE—9. General surgery

EVANGELICAL HOSPITAL

G. ERMAN JOHNSON. Clinical studies of extra-uterine pregnancy
PERCY E. HOPKINS. Clinical studies of pancreatitis.
CHARLES PAPPE. Treatment of lower limb fractures by fixed traction.
PAUL GEORGE PAMSDORF—Demonstration of models and photographs showing newer methods of the handling of fractures of the maxilla and mandible

SHRINERS HOSPITAL

Tuesday

BEVERIDGE MOORE and HAROLD SOFIELD—9. Orthopedic operations.

Wednesday

BEVERIDGE MOORE—2. Demonstration of plaster technique club foot clinic.

Thursday

BEVERIDGE MOORE and HAROLD SOFIELD—9. Orthopedic operations.

Friday

BEVERIDGE MOORE and HAROLD SOFIELD—2. Out-patient clinic.

FRANCES E. WILLARD HOSPITAL

Tuesday

ALLEN E. STEWART and MILTON OCHS—9. General surgical clinic.
FREDERICK MUELLER—3. Surgery of bones and joints.

Wednesday

OTIS M. WALTER—9. General surgical clinic
VAUGHN L. SKEETS—10. Diabetic clinic.

Thursday

JOSEPH F. JAKOS—9. Thyroid clinic.

Friday

VICTOR L. SCHLAGER—9. General surgical clinic.

SOUTH CHICAGO COMMUNITY HOSPITAL

Tuesday

M. E. FINNEY—2. Avertin anesthesia, analysis of 300 cases.
LOUIS D. SMITH—2 30. Tuberculosis of the kidney presentation of case.

Friday

JOSEPH J. LEBOWITZ—2. Fractures and dislocations of the elbow presentation of cases treated by open operation.
FRANK G. MURPHY—2 30. Fractures of the upper end of the humerus, presentation of cases.
GEORGE G. O'BRIEN—3. Postoperative evisceration presentation of case.

HENROTIN HOSPITAL

Tuesday

CRANKING BARRETT—9. Gynecological operations.
F. LEE STONE—9. Some problems in tubal patency

Wednesday

JOHN A. GRAHAM—11. Open reduction of fractures

SURGERY OF THE EYE EAR, NOSE AND THROAT

PRESBYTERIAN HOSPITAL AND RUSH MEDICAL COLLEGE

Monday

- D. B. HAYDEN—2. Complications of otitis media without rupture of the tympanic membrane.
 E. W. HAGGERTY—3. Unusual laryngeal and bronchial case.
 GEORGE E. SCHRAMM, JR. and E. W. HAGGERTY—2. Operations on the tear sac for dacryocystitis.
 MAX JACOBSON—3. Neurological aspects.

Tuesday

- ROBERT VON DER HEYDT—3. Slit lamp diagnostic clinic.

Wednesday

- VENKON LINDEN—3. Glaucoma.

Thursday

- BERTH KLEIN—10. Histopathology of fundus.
 T. W. LEWIS—2. Discussion of some difficult problems in the operation for correction of the nasal septum.
 L. T. CURRY—Demonstration of skiagraphs of the sinuses and mastoids.
 R. W. WATKINS—Nasal findings in allergic cases.
 C. L. DOUGHERTY—2. Diathermy and its application to the treatment of nose and throat conditions.

Friday

- W. F. M. CHAFF—0. External diseases of the eye and endocyclitis.
 ELIAS SELINGER—3. Fundus.

ALBERT MERRITT BILLINGS HOSPITAL

Tuesday

- E. A. L. BROWN—0. Eye clinic.
 J. R. LINDSAY—0-30. Ear, nose and throat clinic.
 DEWEY KATE—2. Eye clinic.

Wednesday

- LOUIS BOTHWELL—0. Eye clinic.
 T. E. WALKER—0-30. Ear, nose and throat clinic.
 JOHN STODOL—3. Eye clinic.
 J. R. LINDSAY and G. H. SCOTT—2. Ear, nose and throat operations.

Thursday

- P. C. KRONFELD—0. Eye clinic.
 G. H. SCOTT and H. B. PERLMAN—10-30. Ear, nose and throat clinic.
 DEWEY KATE—2. Eye clinic.

Friday

- DEWEY KATE—0. Eye clinic.
 J. R. LINDSAY and T. E. WALKER—10-30. Ear, nose and throat clinic.
 P. C. KRONFELD—1. Eye clinic.
 T. E. WALKER and H. B. PERLMAN—2. Ear, nose and throat operations.

EVANGELICAL HOSPITAL

- G. HENRY MURPHY. Technique and interpretation of hearing tests and technique and interpretation of tests of the static labyrinth.

ST LUKE'S HOSPITAL

Monday

- EARL VERNON—2. Ophthalmological clinic.

Tuesday

- E. FREDLAY and RICHARD GAMBLE—3. Ophthalmological clinic.
 J. T. CAMPBELL, JOHN A. CAVANAUGH, HORACE R. LYONS, E. P. NORCROSS, WALTER H. THEOBALD, SYLVIA A. SCIARETTA, ARTHUR J. COOMBS and CLIFFORD L. DOUGHERTY—2. Otolaryngological clinic.

Wednesday

- ALVA SOWERS—2. Ophthalmological clinic.
 J. T. CAMPBELL, JOHN A. CAVANAUGH, HORACE R. LYONS, E. P. NORCROSS, WALTER H. THEOBALD, SYLVIA A. SCIARETTA, ARTHUR J. COOMBS and CLIFFORD L. DOUGHERTY—2. Otolaryngological clinic.

Thursday

- FRANK BRAWLEY and JAMES W. CLARK—2. Ophthalmological clinic.
 J. T. CAMPBELL, JOHN A. CAVANAUGH, HORACE R. LYONS, E. P. NORCROSS, WALTER H. THEOBALD, SYLVIA A. SCIARETTA, ARTHUR J. COOMBS and CLIFFORD L. DOUGHERTY—2. Otolaryngological clinic.

Friday

- E. FREDLAY and RICHARD GAMBLE—2. Ophthalmological clinic.

COOK COUNTY HOSPITAL

Monday

- EARLE B. FOWLER—2. Ophthalmology.
 S. PEARLMAN and N. LEXNER—2. Esophagoscopy and bronchoscopy; surgery of the neck.

Tuesday

- JAMES P. FITZGERALD—2. External diseases of the eye.
 I. MURKAT—2. Clinical and surgical otolaryngology; plastic surgery of face and nose.

Wednesday

- L. T. CURRY—0. Otolaryngology clinical and surgical cases.
 WILLIAM F. MOWCHIEFF—0. Ophthalmic neurology and ophthalmology.

Thursday

- SAMUEL R. GIFFORD—0. Ophthalmic surgery.
 CHARLES F. YERGER—1. External diseases of the eye.
 S. PEARLMAN and N. LEXNER—2. Esophagoscopy and bronchoscopy; surgery of the neck.

Friday

- T. C. GALLOWAY and M. T. LAMPERT—10. Malocclusion about the head, diathermy.
 JAMES P. FITZGERALD—2. Ophthalmic surgery.
 I. MURKAT—2. Clinical and surgical otolaryngology; plastic surgery of face and nose.

CHICAGO EYE, EAR, NOSE AND THROAT HOSPITAL

Tuesday

- H. B. FULLER—9. Mastoid surgery
 WILLIAM A. HOFFMAN and WILLIAM LINGARD—9. Eye, ear, nose and throat clinic.
 WILLIAM A. FISHER—9. Cataract operations.
 L. SAVITT—10. Removal of tonsils by diathermy
 OSCAR B. NUGENT—11. Eye clinic.
 O. M. STEFFENSON—11. Eye, nose and throat clinic.
 T. S. KAMMERLING—12. Eye, ear, nose and throat clinic.

Wednesday

- O. M. STEFFENSON—9. Tonsil dissection.
 OSCAR B. NUGENT—9. Cataract operations.
 WILLIAM A. HOFFMAN and WILLIAM LINGARD—9. Nasal surgery and eye, ear, nose and throat clinic.
 OSCAR B. NUGENT—11. Eye clinic.
 O. M. STEFFENSON—11. Eye, nose and throat clinic.
 L. SAVITT—11. Eye, nose and throat clinic.
 H. B. FULLER—12. Eye, ear, nose and throat clinic.

Thursday

- WILLIAM A. FISHER—9. Eye operations.
 WILLIAM A. HOFFMAN and WILLIAM LINGARD—9. Eye, ear, nose and throat clinic.
 T. S. KAMMERLING—9. Surgery of the nasal accessory sinuses.
 L. SAVITT—10. Physical measures in otolaryngology
 O. M. STEFFENSON—11. Eye, nose and throat clinic.
 L. SAVITT—11. Eye, nose and throat clinic.
 OSCAR B. NUGENT—11. Eye clinic
 T. S. KAMMERLING—12. Eye, ear, nose and throat clinic

Friday

- O. M. STEFFENSON—9. Tonsil dissection.
 WILLIAM A. HOFFMAN and WILLIAM LINGARD—9. Eye, ear, nose and throat clinic.
 OSCAR B. NUGENT—9. Fundus photography and pathology
 H. B. FULLER—10. Functional testing
 O. M. STEFFENSON—11. Eye, nose and throat clinic.
 OSCAR B. NUGENT—11. Eye clinic.
 H. B. FULLER—12. Eye, ear, nose and throat clinic.

MICHAEL REESE HOSPITAL

Monday

- H. S. GRADLE—2 30. Eye surgery

Tuesday

- S. J. PEARLMAN—9. Bronchoscopic clinic.
 M. L. FOLK—12. Eye surgery

Wednesday

- SAMUEL SALINGER—9. Nasal fractures, plastic of the nose
 M. L. FOLK—12. Eye clinic.
 H. S. GRADLE—12 30. Surgical eye clinic.
 ROBERT VON DER HEYDT—12. Slit lamp demonstration.

Thursday

- CASPER EMMERT—9. Cleft palate and hardlip.
 J. C. BECK and M. REESE GUTTMAN—10. Voice production following laryngectomy

RESEARCH AND EDUCATIONAL HOSPITAL

- Otolaryngological Staff F. L. LEINER, W. H. THEOBALD, J. J. THEOBALD, G. S. LIVINGSTON, E. A. BREIDLAU, N. FOX, S. L. SHAPIRO, I. G. SPERMAN, P. A. HALPER, A. C. KANT, A. COOMBS, J. HARMED, O. VAN ALYEA, M. GUTTMAN, S. MORWITZ, M. OSTROM, B. LAM, BRADIS, E. HARTLEY, H. KILWANT, L. FRIEDMAN, H. WADSWORTH, J. BELLows and N. FABRICANT
 Ophthalmological Staff HALLARD BEARD, M. L. FOLK, H. J. SMITH, S. WOLF, S. KAUFMAN, CARL APPEL and J. W. CLARK.

Monday

- Staff—12. Otolaryngological out patient clinic.

Tuesday

- Staff—9. Ophthalmological clinic, operations and demonstrations.
 Staff—10. Otolaryngological out-patient clinic.
 Staff—12. Otolaryngological clinic, operations and demonstrations.

Wednesday

- Staff—9. Eye clinic.
 Staff—10. Otolaryngological out patient clinic.
 Staff—12. Otolaryngological out-patient clinic.
 Staff—4. Otolaryngological seminar

Thursday

- Staff—9. Otolaryngological operations.
 Staff—9. Eye clinic
 Staff—10. Otolaryngological out-patient clinic.
 Staff—12. Otolaryngological clinic, operations and demonstrations.
 Staff—12. Otolaryngological out patient clinic.

Friday

- Staff—9. Eye clinic, operations and demonstrations.
 Staff—10. Otolaryngological out patient clinic.
 Staff—12. Otolaryngological out-patient clinic.

WESLEY MEMORIAL HOSPITAL

Tuesday

- ROBERT BLUE—9. Eye clinic.
 OTIS H. MACLAY—10. Nasal sinus surgery and demonstration of culture technique for the examination of maxillary and frontal sinuses.

Wednesday

- THOMAS P. O'CONNOR—10. Otolaryngological clinic.
 A. H. ANDREWS, E. E. DILLON, A. H. ANDREWS, JR.—12. Mastoid operations on cadaver showing simple modified and radical operations, with a discussion of the indications for each.

Thursday

- CHARLES B. YOUNGER—9. Nose throat and ear operative clinic.

Friday

- ROBERT BLUE—9. Eye clinic.
 OTIS H. MACLAY—10. Nose throat and ear clinic.

ST BERNARD'S HOSPITAL

Friday

- PHILIP O. CONNOR—12. Surgery of the eye dry clinic.

ILLINOIS EYE AND EAR INFIRMARY

Monday

- R. VON DER HYEDT—1. Eye surgical clinic.
S. SALDAGER—2. Ear, nose and throat surgical clinics.

Tuesday

- S. J. MEYER—2. Eye surgical clinic.
G. LIVINGSTON—2. Ear, nose and throat surgical clinic.

Wednesday

- DWIGHT C. ORCUTT—2. Eye surgical clinic.
J. CAVANAUGH—2. Ear, nose and throat surgical clinic.

Thursday

- E. K. FIDELAY—2. Eye surgical clinic.
T. J. NOVAK—2. Ear, nose and throat surgical clinic.

Friday

- T. D. ALLER—2. Eye surgical clinic.
ALFRED LEWY—2. Ear, nose and throat surgical clinic.

MOUNT SINAI HOSPITAL

Monday

- J. C. BECK, M. R. GUTTMAN and associates—2. Septum cases of uncommon variety discussed and presentation of cases of malignancy about the nose and pharynx carcinoma of the larynx, presentation of laryngectomized patients.

Wednesday

- A. LEWY, S. M. MORWITZ and associates—2. Septa associated with ear disease cases of labyrinthitis, treatment of atrophic rhinitis.

Friday

- JAMES E. LEBENSOHN—9. Operations for cataract and squint.
J. LUTCHINSKY, M. A. GLATT and associates—2. Orogenic septic meningitis with recovery; otogenic sepsis with death following blood transfusion tracheobronchial Hodgkin's disease, bronchial melanoma laryngeal chondroperichondritis.

OAK PARK HOSPITAL

Tuesday

- HOWARD RICHMAN—9. Demonstration of new nasopharyngoscope on the cadaver and living.

Thursday

- HOWARD RICHMAN—9. Treatment of maxillary sinusitis with the cold quartz lamp, new method of treatment of maxillary polyp by diathermy.

Friday

- GEORGIANA THEOBALD—9. Demonstration of eye tumors, ophthalmic surgery.

WASHINGTON BOULEVARD HOSPITAL

Tuesday

- L. McBRIDE—2. Nose and throat clinic.

Wednesday

- VIRGIN WESTCOTT—2. Eye clinic.

MERCY HOSPITAL

Tuesday

- GEORGE T. JORDAN—9. Nasal ganglion.
L. G. HOFFMAN—9. Cataract extractions.
C. H. CHRISTOPHER—9. Bronchoscopy.

Wednesday

- GEORGE MURGRAVE and ALFRED FAIRLEY—9. Frontal sinus operation, local anesthesia modified radical mastoid operation with complete removal of sup presentation of cases.

Thursday

- ULTRAMAS J. GRIM—9. Radical antrum and mastoid.
DENO O'CONNOR and RAY KIRWIN—9. Ocular tumors.
CARL SCHRAUB—9. Focal infection in tritis.

CHILDREN'S MEMORIAL HOSPITAL

Wednesday

- GEORGE S. LIVINGSTON and MAX T. LAMPERT—9. Intracranial complications of otitic origin, review of cases.
MAURICE H. COTTELL—9. Focal infections of the nose and throat in arthritis methods of study and treatment.
GLENN J. CHICKENWOOD—9. Intranasal surgery in children.
GEORGE S. LIVINGSTON—9. Introduction of iodized oil into the bronchi in the study of bronchiectasis.
RICHARD GAMBLIK—2. External eye diseases in children.
ELMER VOORHEES—2. Fundus diseases in children.
GEORGE P. GUNTER—2. Orthoptic training in the treatment of strabismus.

CHICAGO MEMORIAL HOSPITAL

Monday

- RICHARD H. STREET and RICHARD W. WATKINS—2. Otolaryngological clinic.

Tuesday

- HERMAN P. DAVIDSON and GLENWAY W. NEIDERHOUT—2. Eye clinic.

Wednesday

- ALFRED E. LEWY and JEREMY J. MURKAT—2. Otolaryngological clinic.

COLUMBUS HOSPITAL

Monday

- MICHAEL GOLDENBERG—2. Emergency surgery of the eye.

Wednesday

- G. B. LAMBRACK—9. Indications for operative treatment in acute mastoiditis.
S. SCHARFET—9. Otolaryngological clinic.
MICHAEL GOLDENBERG—2. Eye surgery.

Friday

- MICHAEL GOLDENBERG—2. Eye surgery.

AUGUSTANA HOSPITAL

Wednesday

- ALFRED MURRAY—2. Eye, ear, nose and throat clinic.

ST JOSEPH'S HOSPITAL

Wednesday

AUSTIN A. HAYDEN—9. Otolaryngological clinic. Tonsillectomy haemostatis, relative importance of blood clotting and bleeding time stumps atresia of the posterior choanal orifices, demonstrated by wax models. Hearing conservation, functional tests mastoid surgery. Submucous resection sinus surgery treatment of fractures. Operations and demonstration of cases supplemented by lantern slides, motion pictures, etc.

ST MARY OF NAZARETH HOSPITAL

Tuesday

GEORGE W. MARONEY—9. Eye clinic.
J. J. KILLEEN—9. Ear, nose and throat clinic.

Thursday

J. J. KILLEEN—9. Ear, nose and throat clinic.

Friday

E. ROBERG—9. Eye clinic.

WOMEN AND CHILDREN'S HOSPITAL

Tuesday

ALICE K. HALL—10. Nose and throat clinic.

Wednesday

FRANCIS HAINES—10. Nose and throat clinic.

GRANT HOSPITAL

Wednesday

S. H. SOBOKOFF—9. Ear, nose and throat clinic.
GEORGE DIEMIS—9. Eye, ear, nose and throat clinic.

SOUTH CHICAGO COMMUNITY HOSPITAL

Tuesday

GEORGE E. PARK—3. The center of ocular rotation in the horizontal plane.

FRANCES E. WILLARD HOSPITAL

Thursday

WILLARD D. BRODE—10. Surgery of throat and nose.

LITTLE COMPANY OF MARY HOSPITAL

Wednesday

H. T. NASH—10. Emergency surgery of the eye.

PASSAVANT MEMORIAL HOSPITAL

Friday

J. GORDON WILSON, JOHN DELPH, CARL BOOKWALTER and ELLISON ROSE—9. Ear, nose and throat clinic.
SAKFORD GIFFORD, WILLIAM MAXON JR. and RALPH DAVIS—11. Ophthalmology

WEST SIDE HOSPITAL

Monday

JAMES CLARK—3. Ear, nose and throat clinic.

Tuesday

A. E. LUNN—3. Eye, nose and throat clinic.

Wednesday

A. E. LUNN—2. Eye, nose and throat clinic.

Thursday

JAMES CLARK—3. Ear, nose and throat clinic.

Friday

A. E. LUNN—2. Eye, nose and throat clinic.

WEST SUBURBAN HOSPITAL

Monday

ROBERT H. GOOD—3. Surgery of the nose, motion picture demonstration.

Tuesday

JOHN J. THEOBALD—3. Mastoid surgery

Wednesday

GEORGIANA THEOBALD—2. Eye pathological exhibit.

SOUTH SHORE HOSPITAL

Monday

JOHN W. STANTON—2. Mastoiditis and its complications.

Thursday

JOHN W. STANTON—11. Otolaryngological surgery

AMERICAN HOSPITAL

Tuesday

HARRY L. POLLOCK and ASSOCIATES—2. Ear, nose and throat clinic.

Wednesday

OSCAR KRAFT—3. Ophthalmological clinic.

ILLINOIS MASONIC HOSPITAL

Tuesday

M. H. COTTELL—10. Some advances in mastoid work.
B. M. WOLFE—10. Tonsil surgery in the poor risk cases.
H. E. TAYLOR—10. Conservative surgery of the nose

JACKSON PARK HOSPITAL

Tuesday

H. E. L. THOM—1. Timm's modification of Slader tonsillectomy

ILLINOIS CENTRAL HOSPITAL

Tuesday

HIRAM SMITH—9. Eye clinic.

Wednesday

JAMES H. McLAUGHLIN—9. Nose and throat surgery

EVANSTON HOSPITAL

Tuesday

THOMAS C. GALLOWAY—*g*. Otolaryngological clinic.

Thursday

HOWARD C. BALLENGER—*g*. Otolaryngological clinic.

Friday

GAIL R. SOMER—*2*. Lesions of the fundus oculi, lantern slide demonstration.

RAVENSWOOD HOSPITAL

Wednesday

A. N. MURRAY—*1*. *30*. Malignancies of the eye.

MOTHER CABRINI HOSPITAL

Tuesday

NOAH FOX, J. W. HARVEY, JR. and F. M. CRACK—*2*. Ear, nose and throat clinic.

Friday

NOAH FOX, J. W. HARVEY, JR. and F. M. CRACK—*2*. External ethmoidal operation.

GARFIELD PARK HOSPITAL

Wednesday

ROBERT H. GOOD—*2*. Submucous resection of the septum on the cadaver and living, motion picture demonstration and discussion.

Friday

ROBERT H. GOOD—*2*. Intranasal tear sac operation on the cadaver and living, motion picture demonstration and discussion.

ST. ANNE'S HOSPITAL

Tuesday

B. T. GORDON—*g*. Nose and throat clinic.

Wednesday

W. K. GRAY—*g*. Eye and ear clinic.

JOHN B. MURPHY HOSPITAL

Monday

E. F. GARRAGHAN—*2*. Eye operations.

Tuesday

L. H. WOLF and PAUL WOLF—*10*. Mastoid surgery.

Friday

GEORGE W. MARONEY—*g*. Cataracts.

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HISTOLOGICAL GRADING IN CARCINOMA OF UTERINE CERVIX

ITS RELATION TO CLINICAL GROUPING AND PROGNOSIS

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From The Bernard Free Skin and Cancer Hospital

CONSIDERABLE interest has been aroused in regard to the significance of the grading of carcinoma since the publication of Broders' work in 1921. Other systems of grading have attracted attention particularly the one devised by Schmitz and Hueper of Chicago, who are the authors of the so called 'malignancy index'. Probably no group of tumors have engendered so much difference of opinion as to the value of grading as the carcinomata of the uterine cervix. In grading our tumors we have used the method of Broders to the exclusion of the Hueper method for the reason that in the latter the personal equation enters and carries too much weight in the result. Broders has arbitrarily divided tumors into four grades. The Grade I tumors are those containing from 1 to 25 per cent of undifferentiated cells. The Grade II tumors have from 25 to 50 per cent, the Grade III from 50 to 75 per cent and the Grade IV from 75 to 100 per cent undifferentiated cells. A group of undifferentiated cells grow so evidently without restraint or self control that the parent structure whether tubule layer cord or palisade cannot be made out. In stead of differentiating into cells of parent type they have embryonic characteristics. Such an area of undifferentiated cells has also been described as being made up of cells that have undergone de-differentiation or

anaplasia. These terms signify the phenomena opposite to differentiation. It may be stated that a cell which goes through its life cycle and takes on the form of its parent is a differentiated cell. Such a group of cells can be seen in the basal cell carcinoma where we have a mass of cells all of them being of the same structure as the basal layer of the normal epithelium. It is only the arrangement of these cells which distinguishes the mass from that of normal basal epithelium. Benign neoplasms, such as the myomata manifest this same self control. Complete self control manifests itself in these neoplasms when de-generation sets in. The normal cells have ceased to regenerate and the remaining ones have differentiated beyond the point of regeneration. Complete differentiation is seen in the epithelial 'pearle body'. In very malignant tumors the regeneration of cells takes place so rapidly that very few and occasionally none of the cells differentiate.

Adverse criticism of grading is sometimes based on the fact that different grades are to be found in different portions of the same tumor. To meet this criticism we have selected only the most rapid growing portion of such tumors as a basis in our grading. Adverse criticism is also based on the fact that at different periods of growth there is a difference in the grade of the tumor. This may



Fig. 2. Tumor tissue is made up of squamous cells with marked tendency to differentiation and characterized by lack of keratin formation. Less than 25 per cent of the cells are undifferentiated. Grade I.



Fig. 3. Keratinization and hyalinization are characteristics of this type of early and not extensive lesion. This represents a type as seen in the base of a cervical polyp. Grade I.

be due to the resistance of the host at varying periods of time. Additional adverse criticism is based on the personal equation. Whatever force there may be in this last objection seems to be inapplicable to this study for we have graded the tumors independently and yet have found less than 1 per cent difference of judgment covering 300 different specimens included in this study.

Some clinicians have attempted to formulate conclusions in regard to the prognosis of cervical (uterine) cancer based on the results of numerous studies on grading of carcinoma of the lower lip. Such conclusions are open to severe criticism. In fact, it is impossible to use

the lip as a basis of comparison for tumors of the cervix, simply on the assumption that in both instances we deal with surface epithelium.

In Table I a comparison is made of an unselected series of squamous cell carcinoma of the lower lip and squamous cell carcinoma of the cervix. It is clearly seen that the two sets of figures are entirely dissimilar. No one has ever reported such a high percentage of cures in cervical cancer as these figures show to be possible in lip cancer (reported by Jorstad from this hospital in 1930).

It is believed and quite well authenticated, that tumors of Grade I being comparatively slow in growth metastasize much later than

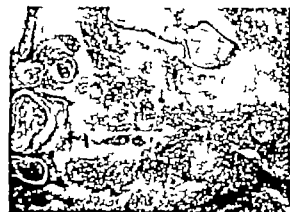


Fig. 3. The usual cellular differentiation, cellular infiltration, vascular changes, and keratinization in this grade and type of malignancy are shown. Grade I.

TABLE I—CARCINOMA OF LOWER LIP

| Grade of malignancy | % living and well 5 years | % of total cases in each group |
|---------------------|---------------------------|--------------------------------|
| I | 80 | 66 |
| II | 76 | 49 |
| III | 60 | 22 |
| IV | | 3 |

CARCINOMA OF CERVIX

| Grade of malignancy | % living and well 5 years | % of total cases in each group |
|---------------------|---------------------------|--------------------------------|
| I | 66 | 1.3 |
| II | 34.5 | 52.3 |
| III | 18.6 | 44.5 |
| IV | 14 | 3 |



Fig. 4. The type described in Figure 1 almost one half of this tumor being undifferentiated. The polypoid arrangement is definite. Grade II.



Fig. 5. This typifies a tumor with less differentiation than the same type of tissue shown in Figures 1 and 2. Grade II.

the less differentiated types of tumor. In cancer of the lip we see 26 per cent of all cases in Grade I, whereas but 13 per cent of the cervical cancers are thus grouped. From the 5 year results in cancer of the lower lip it would seem that knowing the grade of tumor with which the surgeon is dealing he must allow this knowledge to influence greatly his prognosis even though a standard radical procedure of removal or destruction is done in each case. This is not true of the cervix series. In each case we are seemingly dealing with similar squamous cell carcinomata microscopically, but the clinical picture is entirely dissimilar. Early carcinoma of the lip is a common clinical diagnosis but early carcinoma of the cervix is decidedly an uncommon diagnosis on our histories. A relatively late cancer of the lip with metastasis to the regional (submaxillary and submental) lymph

nodes leads to a guarded prognosis, about 25 per cent 5 year cures result in a series of properly treated cases. But when the jugular chain of nodes becomes involved the percentage of 5 year cures falls to 10 per cent and below. This group now becomes equivalent to the cases of cancer of the cervix coming to us, which we clinically group three (according to the Schmitz classification). Remembering this fact, we are in a position properly to analyze our figures, and realize that no direct comparison should be attempted between carcinoma of the lip and cervix.

In Table II we have arranged all cancers of the cervix treated by radium *alone* into clinical groups as well as microscopic grades.

TABLE II—SQUAMOUS CELL CARCINOMA OF THE CERVIX

| Clinical group | Histological | Cases | Length of life after treatment |
|----------------|-----------------------------------|---------------|--|
| I | Grade II Grade III Grade IV | 3 | 8 1/2 months 7 1/2 months 2 months |
| II | Grade II Grade III | 6 | 13 months 6 months |
| III | Grade II Grade III Grade IV | 10 19 3 | 29 months 30 months 4 1/2 months |
| IV | Grade II Grade III | 46 45 | 7 months 6 months |



Fig. 6. The usual architecture seen in these tumors. At least 35 per cent of the fixed tissue cellular structure is differentiated. Grade III.



Fig. 7. A good example of an almost completely undifferentiated tumor with typical stroma. Grade IV.



Fig. 8. Attempts at differentiation are noted, but the cellular structure and relationship places it in this group.

We have used the clinical grouping of the Schmitz classification.

Briefly the Schmitz clinical classification divides cancer of the cervix into groups as follows:

Group I. Malignancy is confined to the uterine cervix.

Group II. Malignancy has spread to the adjacent vaginal wall.

Group III. Uterus is still movable but there is beginning thickening of one or both broad ligaments.

Group IV. Uterus is fixed.

Observing the Table, it is at once obvious that we have no Grade I cases in any clinical group. The reason for this is that all the Grade I cases were found in Groups I and II and these being considered operable had surgical treatment. We have included in this series only those cases that received radium or X-ray therapy, no case treated by surgery alone, or a combination of surgery and radium, is included. Furthermore, no case was considered which could not be traced to the time of death or found living after 5 years. It is only by such measures as these that statistics of this nature become of value. From a study of this chart, it seems evident that *Clinical grouping and extent of disease is more important than grading from a prognostic standpoint.*

Do these figures signify that grading is of no value whatsoever in the study of cervical cancer? We do not believe they do for there

are facts that are not shown in the figures. It has been our observation that the immediate effect of radium on the more undifferentiated type of tumors is greater than on the differentiated types. We find greater immediate retrogression in Grades III and IV than in Grades I and II the clinical extent of involvement being approximately the same, and a like dosage of radium being applied in each case. This is added evidence of the greater radio-sensitivity of Grade III and IV tumors.

From the purely morphological standpoint, there are two types of squamous cell carcinomata of the cervix. The type which may undergo keratinization "pearle formation" is the more usual type. Eighty per cent of the neoplasms in this series are of this type, the four grades being typified in Figures 3, 5, 6, 7, and 8 respectively. The other type does not show this tendency to keratinization when undergoing the varying degrees of differentiation. It somewhat resembles the structural makeup of a basal cell carcinoma, however the squamous type of cell is easily made out (Figs. 1, 2 and 4). As a matter of interest, one of the specimens in this series was made up of a mixture of the two forms (Figs. 9 and 10).

It is also our observation that rectovaginal and vesicovaginal fistule occurred almost always in carcinoma of the Grade III and IV variety after treatment with radium. This fact becomes more significant when it is known that the radium dosage was approxi-



Figs. 9 and 10. The tumor tissue is made up of two types of squamous cell carcinoma, as depicted separately in Figures 1 and 3. Two tumors in our series presented these histological features.

mately the same in a large majority of the cases treated, so that it could not be by but mere chance that the fistulae occurred in the less differentiated types of tumor alone. Therefore, it is safe to assume that patients with vaginal involvement with carcinoma can not with safety receive the same radium dosage, regardless of the grade. The Grade I or II carcinoma will withstand a greater dose with less danger of perforation than will the Grades III or IV. Some Grade I or II carcinomata are so radio-resistant that a combined radium dosage of 7 000 milligrams given over a relatively short period of time has caused little retrogression clinically, and yet we were dealing with a relatively slow growing neoplasm. We unfortunately know from experience the disastrous results to the bladder and rectum that such a large dosage of radium causes when applied to the more rapidly growing more radiosensitive, undifferentiated tumors.

From an analysis of the grading of all the cervical cancers treated by radium in this hospital from 1917 to 1927, it can be concluded that grading alone is of no prognostic value. Due to the concealed location of the tumor, and the absence of early subjective symptoms in the majority of cases of cancer of the cervix, it is impossible to formulate ideas in regard to these neoplasms on the basis of conformity with similar neoplasms of the lower lip. That grading is or may be of great value in the radium treatment of a specific case of carcinoma of the cervix is true, furthermore grading may be the deciding factor in the decision to employ surgical treatment rather than radiation or vice versa.

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CEREBRAL HEMIATROPHY WITH HOMOLATERAL HYPERTROPHY OF THE SKULL AND SINUSES¹

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THE size and shape of the skull is usually dependent upon the degree of development of the brain. Moreover these qualities of the skull and presumably also of the brain vary according to race, individual inheritance and often national custom. What happens to the skull then if the brain through injury or disease suffers a loss of substance? In the course of our examination of many encephalograms a number of cases have come to our attention in which, following trauma to the head or disease of the brain at birth or during early childhood not only does the brain show evidence of marked atrophy and hypoplasia, but the skull presents changes that can be interpreted only as secondary phenomena in response to a diminution of the intracranial contents. In the present study we are confining ourselves to a consideration of those patients in whom these changes in the brain and skull are for the most part unilateral and relatively well marked. A report of 9 cases is included.

LITERATURE

Clinically the patients belong to the group usually called "infantile hemiplegias." The literature on this subject is very extensive and deals with its every phase. There are many discussions especially of the pathological findings in the brain, the peculiar character of the hemiplegia, the nature of the convulsions, and the trophic changes in the hemiplegic extremities. It is also well known and mentioned by most authors that the bones of the face, often including the orbit, show on the hemiplegic side a retarded development which is looked upon as part of the general retardation of growth on that side due to loss of trophic control by the contralateral cerebral hemisphere. Concerning the bony abnormalities of the skull on the side of the affected hemisphere however relatively few references are available.

A thickness of the skull on the side of the brain lesion has been remarked upon by several authors such as Guéneau de Mussy (1830) Bell (1831) Turner (1856) and S. Van der Kolk (1861). Cotard (1868) in fact, was aware not only of this thickening but, in so far as the more or less incompletely studied post mortem material permitted of a dilatation of the frontal sinuses as well. He states: "In the majority of cases the diminution in the capacity of the skull occurs by the retraction of the internal table without any notable deformity of the exterior of the skull. The thickness of the bone becomes augmented. In some cases the bones appear to be blown up, the orbital roof becomes doubled into two layers between which are found large cells which appear to be expansions of the frontal sinus."

Peterson and Fisher, in 1889, reported the cranial measurements in 20 cases of infantile hemiplegia. They concluded that in all their cases there was not only a diminution in all dimensions of the skull and its capacity but that there was an additional diminution in the size of the skull on the side opposite the paralysis.

Freud, in his classical monograph on "Die Infantile Cerebrallähmungen" (1897) gives the most complete summary of the literature on this aspect of the problem. His opinion is worth quoting since it represents the essence of the conclusions reached not only up to his time but to this very day. He says: "The undoubted interrelation between the growth of the brain and the overlying parts of the skull is apparent in numerous ways in the cerebral hemiplegias. The skull seems to profit, according to him by the release from pressure of a growing brain and becomes thickened over areas where the brain is sunken in. The inner table appears heaped up and the orbital cavities as if blown up" (quoting Cotard). In other cases, he observes, there is an inhibition of growth of the skull corre-

sponding to the affected hemisphere, the vault fails to develop, or there may even be a depression. Sometimes, indeed, in post traumatic cases an actual defect in the bone exists. All these changes, however, are inconstant and are to be expected most often in children whose illness begins early in life.

Oppenheim declares that "changes in the bones of the skull, depression defect formation (porocranu) diminution in circumference hypoplasia of the vault upon the side of the brain lesion form an inconstant symptom."

Déjerne, too, says that "one sometimes finds a flattening even a depression of the vault of the skull at a point corresponding to the cerebral lesion especially when potencephaly is present but this finding is not constant."

Pentz, in the new edition of his book refers to "growth disturbances in the skull in infantile hemiplegia without describing them."

In the numerous comprehensive monographs on the subject of infantile hemiplegia little comment is to be found on the skull changes that we have been able to demonstrate on the roentgenograms. The explanation probably lies in the fact that many of these monographs were written prior to the introduction of roentgenography and that recent studies lay so much stress on cerebral pathology as seen in the pneumoencephalograms that the abnormalities of the skull in roentgenograms receive scant attention.

CASE REPORTS

CASE 1 Eileen S. N. L. No. 9020H, aged 23 years, admitted to Institute June 22, 1931. Severe illness with fever at 14 months accompanied by convulsions and a left hemiplegia which have continued to date. Hypertrophy of the skull sinuses and mastoid on the right side, dilatation of the right lateral ventricle, displacement of ventricles to right.

Complaint. Nervousness and irritability, convulsions and left sided weakness.

Present illness. The patient is one of five children. She was born without difficulty and remained in apparent good health during her first year of life. At 14 months she is said to have had an acute illness accompanied by high fever which was thought to be infantile paralysis. Convulsions occurred at this time and a paralysis of the entire left side was noted. The left side of the mouth and both eyes were crooked. After recovery from the acute illness, convulsions recurred once annually until the age of 3 when they began to take place monthly and became

more severe. This has continued up to the present time. The seizures have been mostly nocturnal and have been generalized in character. The patient's health has been good otherwise. She reached the seventh grade in school but has never worked because of deformity. Her past and family history are of no importance.

Physical examination. The patient is a well nourished and well developed young woman but for the left extremities which are underdeveloped. She is nervous, irritable, and reserved, but seems mentally normal. The left side is spastic, with exaggerated reflexes and a positive Babinski and confirmatory signs. She also has a left hemiparesis. The examination is otherwise negative.

Laboratory findings. Negative.

Roentgen-ray examination. The plain films of the skull show a marked thickening of the right half of the frontal bone. The right ethmoid and frontal sinuses are greatly enlarged and extend laterally and backward to include the anterior clinoid process. There is overdevelopment of the right mastoid and extensive pneumatization of the petrous portion of the right temporal bone (Fig. 1).

Encephalograms show the bony changes described above, and in addition a dilatation of the right lateral ventricle with a shift of the entire ventricular system toward the right side displacing the midline structures of the brain to the right. It is apparent that the right side of the cranial cavity is much smaller than the left. The sulci markings are practically absent over both cerebral hemispheres (Figs. 2 and 3).

Although the illness that initiated the present condition was obscure in nature and was probably not 'infantile paralysis' as suspected at the time, it was apparently an infectious process of the brain affecting a hitherto normal infant. The right sided cerebral atrophy was anticipated clinically but the accompanying right sided hypertrophy of the skull and sinuses was unexpected as characteristic associated findings.

CASE 2 Lena L. N. I. No. 7014H, aged 19 years, admitted to Institute January 13, 1931. Onset of right sided paralysis and sensory Jacksonian seizures after febrile attack at 1 year, right homonymous hemianopia, mental retardation. Thickening of bones of left side of skull, overdevelopment of left ethmoid and mastoid cells, dilatation of left lateral ventricle, displacement of ventricles to the left. Operation disclosed a markedly degenerated sclerotic left hemisphere.

Complaint. Paralysis of the right arm, pain in right side of the head.

Laboratory examination in these cases consisted of routine blood and urine examinations, blood W. sedimentation, and spinal fluid, cells, globulin, total protein, W. sedimentation, and colloidal gold test.



Fig. 1



Fig. 2



Fig. 3

Fig. 1. Case 1. Anteroposterior roentgenogram showing marked thickening of the right side of the skull, with overdevelopment of the right ethmoid cells and hyperpneumatization of the right petrous ridge. Arrows point to the thickened bone, the enlarged right ethmoid cell, and the aerated petrous ridge.

Fig. 2. Case 1. Anteroposterior encephalogram showing the dilatation of the right lateral ventricle with displacement of the ventricular system toward this side, also the

changes seen in Figure 1. Arrows point to the unilateral thickening of the skull and overaeration of the petrous ridges.

Fig. 3. Case 1. Lateral encephalogram showing the extensive aeration of the superior orbital plate, including the anterior clinoid process on the right, due to an extension laterally of the ethmoid cells. Note the marked thickening of the right half of the frontal bone and the dilatation of the right lateral ventricle.

Present illness. The patient was the third child in the family, born normally at full term, weighing 9 pounds. She was in good health and developed normally until 12 months of age when she was taken suddenly ill with high fever. That night she had a convulsive seizure beginning on the right side and becoming generalized. Such convulsive attacks recurred at intervals until the age of 3 years. After the first seizure the baby began to rely on her left arm and hand, the right remaining almost entirely useless. Gradually the paralyzed upper extremity began to turn in at the wrist and as time went on its development, as compared to the left, became retarded. Involvement of the right lower extremity was not evident. Between the ages of 3 and 16 she was in fairly good health. Mentally she was somewhat backward, having reached only to Grade 8A when she left school at 17.

When 16 years of age she began to have a new type of seizure. This begins with a "gripping pain" in the right temple which lasts from 3 to 10 minutes and leaves her feeling very weak. The pain is accompanied by a sensation of numbness in the right arm and numbness and weakness in the right leg. Sometimes the right side of the face also feels numb and speech becomes difficult. All those associated signs outlast the pain in the temple, as a rule, by several minutes. These seizures occur at intervals but appear on the average of once in 3 days.

Physical examination. The patient is a well nourished mentally retarded girl of 19. She limps in walking owing to weakness and underdevelopment of the right lower extremity. The right arm is also weak and hypoplastic. The entire right side is spastic with increased reflexes, but with an absent Babinski reflex. A complete right homonymous hemianopsia is present.

Laboratory findings. Results of all clinical laboratory tests were within normal limits.

Roentgen-ray examination. There is marked thickening of the left side of the skull, especially of the parietal and temporal bones. The left superior orbital plate is much thickened by the formation of cancellous bone between the outer and inner tables, and pneumatization by the overdevelopment of the ethmoid cells. There is also thickening of the left anterior clinoid process and the left sphenoidal ridge. The mastoid cells on the left are overdeveloped and have pneumatized the petrous portion of the temporal bone (Fig. 4).

Encephalograms show a dilatation of the left lateral ventricle with a shift of the ventricular system toward the left and a definite decrease in the capacity of the left side of the cranial cavity. No sulci markings are present over the upper half of the left cerebrum. Coarse sulci markings are visible in left lower frontal and temporal areas; normal sulci markings seen over right cerebral hemisphere (Figs. 5, 6).



Fig. 4.



Fig. 5



Fig. 6

Fig. 4. Case 2. Anteroposterior roentgenogram showing the increased thickness of the left side of the skull. The pneumatization of the left petrous bone is well seen in this view.

Fig. 5. Case 2. Anteroposterior encephalogram showing the enlargement of the left lateral ventricle and the displacement of the entire ventricular system to the left. There is an absence of sulci markings over the upper half

of the left cerebral hemisphere, while in the temporal region the cortical markings are coarse. Note also the thickening of the skull on the left and the pneumatization of the left petrous pyramid.

Fig. 6. Case 2. Postero-anterior encephalogram showing the enlargement of the left lateral ventricle and its displacement to the left. The pneumatization of the petrous pyramids is well shown in this view.

Operation. At another hospital a left osteoplastic flap was turned down with considerable difficulty owing to the thickness of the bone, which measured 1.5 centimeters in some areas. The brain showed generalized atrophy with narrow convolutions and widened sulci. Faradic stimulation of the motor area produced no reaction. The cerebrum was tough, resembling cartilage in consistency. A small piece of cortex was removed for biopsy. Histological examination of this tissue showed marked gliosis with practically no ganglion cells.

As in the previous case the onset was signalized by an acute febrile episode in infancy which was accompanied by generalized convulsions. These convulsions continued to be generalized in character in spite of the presence of a hemiplegia until she was 3 years old. It is to be noted that a latent period existed between the ages of 3 and 16 years during which she was free from seizures of any kind. The present attacks which began at 16 have a definitely focal character.

The roentgenograms show changes strikingly similar to those of the first case and in retrospect the clinical picture in this case might have been predicted from the appear-

ance of the roentgenograms even without the aid of air injection.

CASE 3. Jeanette S, N.I. No 12539H aged 14 years admitted to Institute May 17 1932. Fall at age of 1 frequent minor seizures occasional generalized convulsion mental deficiency right hemiparesis. Thickening of left side of skull hypertrophy of left frontal ethmoid, and mastoid cells dilatation of left lateral ventricle shift of ventricles to left decreased capacity of left side of cranial cavity.

Complaint. Nervousness and spells.

Present illness. This patient is an only child, delivered through a caesarean section. She was well until 1 year of age when she fell from a perambulator to the sidewalk striking her head severely. She had an immediate shaking spell, followed by a convulsion which lasted almost all night. High fever was present for about 3 days. She remained in a hospital for 2 months and when she was brought home, the parents found that the right hand and arm were drawn across the chest and one of the legs could not be used well. Ever since then she has had frequent spells of unconsciousness lasting 2 to 3 minutes. When she grew old enough to describe these spells she began to complain of dizziness a peculiar taste which she identified with bread and haziness of vision. In addition to these spells she had isolated severe convulsive seizures at the ages of 5 and 10. The child was late in walking



Fig. 7

Fig. 7. Case 3. Anteroposterior encephalogram showing definite enlargement of the left lateral ventricle and a slight shift of the entire ventricular system to the left. Note again the thickening of the left side of the skull.

Fig. 8. Case 4. Postero anterior roentgenogram showing the increased development of the left frontal and ethmoid sinuses. The arrows point to the slightly pneumatized



Fig. 8.

left petrous pyramid and to the overdeveloped left ethmoid cells.

Fig. 9. Case 4. Anteroposterior encephalogram showing asymmetrical enlargement of the lateral ventricle, more marked on the left. There is also a slight shift of the ventricular system to the left. Some thickening of the skull is present bilaterally but more marked on the left.



Fig. 9.

and talking and has shown mental deficiency since early childhood.

Physical examination. The patient is well developed and well nourished. There is a hemiparesis and hypoplasia of the right side of the body. The reflexes are increased on the right, and there is a questionable Babinski sign on the right. She has a scoliosis of the thoracic spine with the convexity to the right and a right talipes cavus. On Terman test she shows a mental age of 8 years and 8 months with an intelligence quotient of 59.

Laboratory findings. All clinical laboratory examinations on the blood, urine, and spinal fluid were negative.

Röntgen-ray examination. The skull on the left side is definitely thickened. The left ethmoid and frontal air cells are hypertrophied. The left petrous ridge is pneumatized by an extension into it of the mastoid cells.

Encephalograms show a dilatation of the left lateral ventricle and a displacement of the ventricular system to the left. The capacity of the left side of the cranial cavity is distinctly smaller than the right. Normal sulci markings are seen over the right cerebral hemisphere while none are visible over the diseased cortex (Fig. 7).

The etiology in this case is obviously a trauma occurring after birth with immediate onset of convulsions and hemiplegia. The peculiar nature of the seizures, associated by

hallucinations of taste which have persisted to date, are further evidence of the focal character of the lesion. In this patient, with a post traumatic cerebral degeneration the changes in the skull were similar to those seen in the cases previously described in which the intracranial lesion was the result of an infectious process.

CASE 4. Edward H., N.I. No. 9717 aged 15 years admitted to the Institute August 28 1931. Probable birth injury convulsions at 7 months right hemiplegia mental deficiency. Skull on X-ray examination shows thickening greater on left overdevelopment of ethmoid and mastoid cells, dilated left lateral ventricle shift of ventricles toward the left.

Complaint. Convulsions.

Present illness. The patient was a first child born at full term. He was a rather large infant at birth, weighing 8½ pounds (3863 grams) and his mother was in labor 48 hours. The eventual delivery was instrumental, but the child reacted quite normally. At 7 months he began to have convulsions, generalized in character which recurred at short intervals until the age of 10 years. He was free from seizures from 10 to 12½ years, then began to have both major and minor attacks. The former were initiated by flashes of light which were followed by spasms on the right side, urinary incontinence,



Fig. 10.

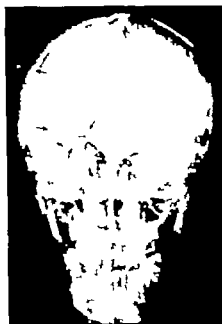


Fig. 11



Fig. 12

Fig. 10. Case 5. Anteroposterior roentgenogram showing the overdevelopment of the right frontal and ethmoid sinuses and acration of the right petrous pyramid.

Fig. 11. Case 5. Anteroposterior roentgenogram (under exposed) shows marked thickening of right half of skull.

Fig. 12. Case 5. Anteroposterior encephalogram showing the enlargement of the right lateral ventricle and the shift to the right of the entire ventricular system. Note also the changes that are present in the skull and sinuses.

and drowsiness. The latter consisted of momentary flashes of light only. The patient has been somewhat backward at school which he quit at the age of 12 after reaching Grade 5A. He was especially deficient in arithmetic.

Physical examination. The patient is a rather tall somewhat obese, dull boy. There is present a right spastic hemiplegia with underdevelopment

and deformity of the paralyzed side and a hypalgnesia and hyperesthesia of the right side as well. Reflex changes are in conformity with the other findings. No hemianopsia exists.



Fig. 13. Case 5. Lateral encephalogram which shows the enlargement of the entire right lateral ventricle. The arrows point to the pneumatized superior orbital plate of the right side.



Fig. 14. Case 6. Anteroposterior encephalogram showing the dilatation of the right lateral ventricle and the shift of the ventricles to the right. Note the asymmetry of petrous pyramids and thickening of right half of skull.



Fig. 5. Case 7. Photograph of Douglas G. showing the underdevelopment of the left side of the body and the hemiplegic attitude.

Laboratory findings. All clinical laboratory examinations on the blood, urine, and spinal fluid showed negative results.

Röntgen-ray findings. The tables of the skull show a thickening beyond normal for this age and this thickening is more apparent on the left side. The left ethmoid cells are overdeveloped and extend well backward into the orbital plate. The petrous portion of the left temporal bone is pneumatized (Fig. 8).

Encephalograms show a dilatation of the left lateral ventricle and a slight dilatation of the third ventricle with a displacement of the ventricular system toward the left. The capacity of the left side of the cranial cavity is markedly less than that of the right side. Delicate apparently normal sulci are outlined by air on the right side, but on the side of the cerebral lesion no air is demonstrable over the cortex (Fig. 9).

This patient began to have convulsions with no other etiologic factor than a difficult birth. The fact that the seizures did not begin until 7 months of age is quite compatible with the belief that the birth injury produced the underlying cerebral defect. In spite of the difference in etiology the changes seen on the encephalograms and on the plain

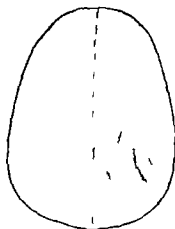


Fig. 16. Case 7. Sketch of the scalp, seen from above, illustrating the redundancy of the soft tissues over the flattened right side of the skull.

films of the skull are very similar to those seen in the preceding cases.

CASE 5. Irene J., C.I.L. No. 22218, aged 15 years, admitted to the Institute March 7, 1932. Sudden onset at 6 years, convulsions, left hemiplegia, mental retardation. Thickening of right side of skull, overdevelopment of right ethmoid and mastoid cells, dilated right lateral ventricle and displacement of ventricles toward the right.

Complaint. Convulsions and left sided weakness.

Present illness. The child is the fifth in the family and was born at term after a short and normal labor. She was apparently quite well until the age of 6. At this age, one morning at 9:30, she had a sudden convulsive seizure causing her to fall to the floor. The left arm drew up in flexion and adduction; later all four extremities became involved. She was unconscious during the attack. The Board of Health considered it a case of "infantile paralysis." The child was hospitalized for a period of 6 months where she remained in bed for the greater part of this time because of the frequency of the seizures. She continued to have convulsions after discharge, although during 1929 and again in 1930 she had periods of almost a year each without convulsions.

Since November 1931 the attacks have been almost a daily occurrence. She calls out in a stiff manner; the left forearm becomes slowly fixed at the elbow; all four extremities then become tense; she grows very pale; is incontinent of urine. She may remain sitting or standing, no clonic movements occur. The seizures usually last 5 minutes after which she may feel drowsy or sleep for a short time.

The girl is apparently mentally retarded; her memory is poor and her reactions rather infantile.

Physical examination. The patient is a well developed, pubescent girl with a spastic contracted



Fig. 17

Fig. 17 Case 7. Anteroposterior encephalogram showing the marked enlargement of the right lateral ventricle and the displacement of the ventricles to the right. Note the enlarged sinuses on the right.



Fig. 18

Fig. 18 Case 7. Postero-anterior encephalogram showing the asymmetry and thickening of the right side of the



Fig. 19.

skull in addition to the changes which are described in Figure 17.

Fig. 19. Case 7. Lateral encephalogram showing the extensive enlargement of the right lateral ventricle. Note the flattening of the posterior portion of the parietal bone, the result of birth trauma.

left arm and a spastic left lower extremity. Reflexes are definitely increased on the left, but no abnormal reflexes are present. Sensation is normal. There is an incomplete left homonymous hemianopia. There appears to be a left facial atrophy associated with a hypoplasia of the left extremities and left half of the body.

Laboratory findings. All clinical and serological examinations of blood, urine, and spinal fluid proved negative.

Röntgen-ray examination. The right side of the skull shows a thickness of the vault of 11 millimeters as compared to 4 millimeters on the left. The right orbital plate up to the base of the anterior clinoid process is widened by the extension of the ethmoidal cells between its tables. The petrous bones are hypertrophied by unequal pneumatization, the right being much larger than the left (Figs. 10 and 11).

Encephalograms show a dilatation of the right lateral ventricle with displacement of the entire ventricular system to the right. The capacity of the right side of the cranial cavity is markedly smaller than that of the left side. A few fine sulci markings are present on the left, but none are visible on the right side (Figs. 12 and 13).

This is another case with a history suggesting an infectious cerebral process at the onset of the illness. Obviously it was not acute anterior poliomyelitis as suggested at the time, although the infectious agent may have been similar to the one causing this disease. In any event the result of this illness

was an extensive right cerebral damage with consequent characteristic changes in the skull.

CASE 6. Elizabeth R. N.I. No 5062H, aged 15 years, admitted to the Institute July 30 1930. Probable birth trauma. Left hemiplegia first noted a few months after birth, generalized convulsions since the age of 5, subnormal mental development. Hypertrophy of right side of skull and sinuses with dilatation of right lateral ventricle and decreased capacity of right side of skull.

Complaint. Generalized convulsive seizures, severe frontal headache, left sided weakness.

Present illness. The patient was the second child, born at full term by an apparently normal delivery. However within a few months after birth, the mother noticed that her left hand was smaller than the right, and that she did not use it. When the patient began to walk, at 1 year her mother noticed weakness, stiffness, and dragging of the left foot. Mental development was apparently normal.

At 5 years of age she began to have generalized convulsions initiated by a cry. These attacks occurred once or twice monthly and were followed by severe frontal headache, nausea, and sometimes vomiting. Between attacks, the child often complained of "heaviness" and dull pain in the left arm. In the past few years she has been somewhat slow in comprehension and lacking in alertness. She reached the fifth grade in school at the age of 13.

Physical examination. A pale undernourished girl with left sided spastic paralysis. There are occasional involuntary twitchings of the paralyzed extremities. These show hyperactive reflexes and a mild degree



Fig. 30. Case 8. Anteroposterior encephalogram showing the marked enlargement of the right lateral ventricle with a shift of the ventricular system to the right. This figure shows unusually well the hyperpneumatization of the right petrous pyramid. There is some overdevelopment of the right frontal and ethmoid sinuses and slight homolateral thickening of the skull.



Fig. 31. Case 8. Postero-anterior encephalogram showing the marked enlargement of the posterior portion of the right lateral ventricle.

of hypalgnesia. There is a questionable left positive Babinski sign.

Laboratory findings: The clinical laboratory examinations proved negative including spinal fluid examination. Basal metabolic rate was minus 16.

Röntgen-ray examination: There is definite thickening of the skull on the right side with a moderate degree of overdevelopment of the frontal sinus on the right as seen in the plain films. The petrous portion of the temporal lobe on the right side shows considerable pneumatization.

Encephalograms show a dilatation of the right ventricle. All the sulci are widened but this is more evident on the right as compared to the left side. There is a shift of the entire ventricular system toward the right. The capacity of the right side of the cranial cavity is distinctly smaller than the left (Fig. 14).

This child has had left sided paresis since early infancy. Whether the cerebral lesion developed at the time of birth or during intra-uterine life cannot be determined. However the picture both from a clinical and roentgenological standpoint closely resembles that seen in the other cases. Unlike so many of the other cases however sulci markings on the affected side are not only present but appear to be coarser than in normal individuals. It is of interest that while the paralysis was evident

shortly after birth the convulsive seizures did not begin until she was 5 years of age.

CASE 7. Douglas G., N.I. No. 12456 aged 16 years, admitted to the Institute May 9, 1931. Birth trauma, left hemiplegia slight mental retardation onset of Jacksonian seizures, later becoming generalized at 15 years. Overdevelopment of the ethmoid sinus and mastoid with slight thickening and marked flattening of the skull on the right side. Dilatation of right lateral ventricle and shift of ventricular system toward the right reduced capacity of the right side of intracranial cavity. Surgical exploration disclosing extensive adhesions and degenerated sclerotic brain on right side.

Complaints: Convulsions, left sided paralysis, backwardness in school.

Present illness: The patient was the first child and was born after a 36 hour labor by an instrumental delivery. Following birth he had a bump on the right side of the head which took 3 weeks to disappear. From the very beginning there was great difficulty in making him nurse. On the third day he "turned yellow" and lost several pounds, and the mother was told he had had a hemorrhage of the brain.

At 5 months of age, the mother first noted paralysis of the left hand and leg. He first walked at 20 months of age and began to speak articulated words at the end of the second year. The paralysis may have improved somewhat, but continued evident up to the present time, and the child's mental development was always somewhat below par.

In July 1931 the patient had his first convulsion, since which time he has had an average of about one a month. The seizures were characterized by a turning of the head to the left followed by unconsciousness, and falling backward and to the left. At first, after falling, the left side alone was seized

by a series of clonic spasms but since December 1931 the entire body participates in the convulsion. The day following the attack he was restless, complained of headache, and dragged the left foot more markedly than before.

Physical examination. The patient is a tall, thin boy showing marked underdevelopment of the left side of the body (Fig. 15) especially noticeable in the left arm and leg. Corrugation of the scalp is noted over the right parietal region corresponding to the flattening of the skull on this side (Fig. 16). There are weakness and spasticity in the underdeveloped extremities with increase of deep reflexes and positive Babinski and Chaddock signs. There is a scoliosis with the convexity to the left in the mid-thoracic region. No sensory disturbances are demonstrable. A marked left homonymous hemianopsia is present. Mental tests prove him to have a low average mental capacity.

Laboratory examination. The laboratory tests on the blood, urine, and spinal fluid were negative.

Röntgen-ray examination. There is slight thickening and rather marked flattening of the right side of the skull. The ethmoid sinus on the right side is overdeveloped and extends posteriorly over the orbit. The right mastoid cells have pneumatized the petrous portion of the temporal bone on that side.

Encephalograms show an enormous dilatation of the right lateral ventricle with a marked displacement of the entire ventricular system toward the right. All of this results in an extensive reduction in space occupied by the right cerebral hemisphere. Sulci markings which appear normal on the left, are not demonstrable over the defective hemisphere (Figs. 17, 18, 19).

Treatment. While nothing could be promised by operation the patient's family was anxious to have everything possible done for him and a right cerebral exploration was carried out.

Operation. June 10, 1932 a right temporoparietal osteoplastic flap was made. The under surface of the dura was adherent to the pialarachnoid. After separating innumerable fine adhesions, a thin shell of degenerated, sclerotic brain fell away from the dura. So far as could be seen, no healthy brain tissue was present anywhere in this entire half of the cerebrum. The lesion was so extensive that removal of the scar tissue was unthinkable since this would have been tantamount to a removal of the entire hemisphere. It was hoped however that a separation of all the fine avascular adhesions might reduce the tendency to convulsive seizures. A specimen of the sclerotic cortex was taken.

Pathological report. The tissue consists almost entirely of fibrillary astrocytes and glial fibrils. Aside from a rare very markedly degenerated, almost unrecognizable ganglion cell the preparation might easily be mistaken for one originating from a fibrillary astrocytoma.

Postoperative course. The boy made an uneventful recovery and was discharged 15 days after the

operation. During his stay in the hospital he did not have any convulsive seizure. He was seen 6 months after discharge at which time he and his mother reported that the convulsions had returned, but that they were less frequent and less severe than before the operation.

This patient's malady obviously followed trauma during birth. He showed even more strikingly than the previous patient, the long interval between the time of the injury and the onset of convulsive seizures. The roentgenograms are again characteristic, although there is much less thickening of the skull of the affected side which has apparently been compensated for by the unusual degree of flattening of the skull on the side of the cerebral lesion.

The operation disclosed an atrophy and sclerosis which involved almost the entire right cerebral hemisphere and histological examination revealed practically no parenchymatous brain tissue. It should also be noted that the sclerotic hemisphere was everywhere adherent to the dura, which probably accounted for the absence of sulci markings on this side of the brain in the encephalogram.

CASE 8. Lillian G. N.J. No. 12849, aged 9 years, admitted to the Institute June 15, 1932. Acute onset. Unconsciousness, fever, and left hemiplegia at 15 months. Left Jacksonian seizures beginning at 6 years, feeble mindedness. Hypertrophy of right ethmoid and mastoid cells. Dilatation of right lateral ventricle with a shift of ventricular system to the right.

Complaint. Convulsions and paralysis of the left arm.

Present illness. The patient is the third child born at term by a normal delivery. She was entirely well until 1 year of age when she had apparently uncomplicated measles. At 15 months she became suddenly ill, vomited, and became unconscious. This lasted for a week and was accompanied by high fever. On regaining consciousness, it was noted that she had a left hemiplegia. The hemiplegia gradually disappeared during the following 2 years except for a residual in the left upper extremity. At the age of 3 she had mastoiditis on the left, complicated by erysipelas. This was successfully operated upon but a sinus has remained with occasional discharge of pus.

She had mumps at 6 years and this was followed by the onset of convulsive seizures. The attacks occurred during the early hours of the morning and consisted of a premonitory cry followed by a jerking of the left arm and unconsciousness. There was frothing at the mouth and often incontinence but no generalized convulsive movements. At first the attacks came once a month but recently they have

occurred almost nightly. During the week previous to admission she complained of pain in the left arm.

Physical examination. The child is well nourished and co-operative. She has a left spastic hemiparesis and the paretic extremities are shorter and smaller than the right. The deep reflexes on the left are hyperactive, left abdominal reflexes are absent, and Babinski's sign on the left is positive. Sensation and visual fields are apparently normal. On the Terman test the child shows a mental age of 3 years and 4 months, with an intelligence quotient of 55.

Laboratory findings. Clinical laboratory findings on the blood, urine, and spinal fluid are negative.

Röntgen-ray examination. There is a thickening of the right orbital plate and an elevation of the right petrous ridge due to pneumatization. However there is no thickening of the skull.

Encephalograms show a markedly dilated right ventricle with a displacement of the ventricular system toward the right. The capacity of the right side of the cranial cavity is distinctly smaller than that of the left. Sulci markings are not visible over either hemisphere (Figs. 30 and 31).

This is another case with an infectious etiology. The patient also showed a long latent interval between the acute stage of the disease and the appearance of seizures. In this case the onset of the attacks seems to have coincided with an attack of mumps. The roentgenograms are again quite typical except for the absence of thickening of the cranial vault.

CASE 9. Richard P. N. I. No. 12907, aged 8 years, admitted to the Institute June 31, 1932. Birth trauma, delayed walking and talking, clonic seizures since age of 5. At 6 onset of focal seizures on left side, left sided weakness and subnormal mentality. Moderate overdevelopment of the sinuses and mastoid on right, no thickening of skull, capacity of right half of cranial cavity less than left, right ventricle larger than left and ventricles shifted slightly to right.

Complaints. Convulsions and left sided weakness.

Present illness. The birth was precipitate and the child was born with the umbilical cord around his neck. He was cyanotic for several hours after birth and took the breast with difficulty. He did not sit up until 1 year of age, did not begin walking until 3½ years, and talking at 3 years. At 4 he had measles and diphtheria. About a year later he had a seizure consisting of shaking of the whole body without loss of consciousness. A similar attack occurred about 3 months afterward. At 6 he began to have attacks of a different character which have continued to date. These are preceded by irritability and headache. The seizure consists of pain in the left arm and left side of the face, followed by twitching movements in these parts which later involve the left leg. This lasts for about 5 minutes after which he usually becomes unconscious and the con-

vulsions continue, clonic in character and confined to the left side, for a period of 2 or 3 hours. These seizures have occurred about once every 2 months during the past 2 years.

He has never been to school and has never learned to write. The family history is entirely negative.

Physical examination. The patient is a well nourished boy who is obviously somewhat mentally defective. He walks with his knees slightly flexed and his mouth open, and there are no associated movements of the upper extremities. There is obvious weakness and awkwardness in the use of the left upper extremity as well as a positive Babinski sign on the left.

Laboratory findings. The clinical laboratory examinations were negative.

Röntgen-ray examination. Plain films of the skull show slight thickening of the right orbital plate. The right ethmoid and frontal sinuses extend posteriorly and partially pneumatize the orbital plate. The mastoid on the right is overdeveloped, and air cells extend well into the petrous portion of the temporal bone.

Encephalograms show the right ventricle to be considerably dilated and the entire ventricular system is displaced somewhat toward the right side. The capacity of the right side of the intracranial cavity is smaller than the left. Coarse sulci markings are present over the medial and superior aspects of the right cerebral hemisphere.

In this case, the child suffered from asphyxia at birth rather than violence to the head. The retarded development, however, would indicate some cerebral disturbance since that time. The failure by the family to note a left hemiparesis even at the time of admission to the hospital makes it impossible to say how early this condition appeared. It may very well have been present at birth. From the previous cases, it is obvious that the delayed appearance of seizures until the age of 5 is compatible with an acute episode at birth.

The changes seen in the roentgenograms of this, as well as the preceding case, are typical although less marked than the others. This is probably due to the youth of these patients at the time of examination (9 and 8 years, respectively) for it seems likely that the thickening of the skull and the overdevelopment of the sinuses take many years to reach their maximum degree.

ETIOLOGY

The clinical picture of infantile hemiplegia has been so frequently and so adequately described in monographs, papers, and stand-

and textbooks of neurology that very little can be added here. For the most part, our cases correspond to the classical description presented by Freud, Oppenheim, Déjerine, Sachs, Peritz, and others. Sachs distinguishes between prenatal, birth, and postnatal paralyses. Among our 9 cases, there was only one possible example (Case 6) of the prenatal type. Two cases occurring during birth were probably due to instrumental or otherwise difficult birth. One patient was evidently the victim of partial asphyxiation due to a tight umbilical cord around his neck. Of the 5 other patients, 4 showed a sudden onset postnatally, with fever, convulsions, and hemiplegia, and in the fifth the symptoms began after a severe fall at the age of 1 year. From this it is evident that uniformity of etiology is out of the question. Moreover, the same may be said for the pathological process. Most of the lesions described by others at postmortem and noted by us during operation are end processes of some previous disturbance. They are usually focal cerebral defects of varying extent: softening, cyst formation, scar formation with contraction, induration, or defect of the cerebrum (porencephaly). The latter is usually located in the distribution of the middle cerebral artery and is probably secondary to disease of this vessel.

Clinically, too, the picture is a varied one. The hemiplegia may occur immediately or be noted some time after the trauma or acute infectious episode. The convulsions may likewise be present at once, or start many months, sometimes many years later (see Case 7). There is often a noteworthy interval of months, sometimes years, between convulsions. Finally the seizures may change completely in character (see Cases 2, 4, and 9), or a second type of seizure may appear which runs in a cycle independent of the original type (Case 3). At the onset of the disease the convulsions may be either generalized or initiated by a motor Jacksonian attack. In Case 2 for example the illness started at 1 year with seizures beginning with right sided twitching going over to generalized clonic convulsions. These attacks recurred frequently until 3. There were no attacks between 3 and 16 years of age. Seizures then made their appearance

which consisted of gripping pain in the right temple in addition to numbness in the right arm, leg, and face, and difficulty in speech. The later seizures, however, often take on the character of a sensory discharge.

The one thing that all of these patients show in common is the early age of onset of the disease. All our patients date their illness back either to birth or to within the first 15 months of life, with the exception of Case 5 in which the symptoms began at 6 years. This fact appears significant in accounting for the profound and uniform changes in the skull.

It is common knowledge that the infant's skull is relatively soft and malleable and that external factors such, for example, as strapping the child on a board, as commonly practiced among primitive races, results in corresponding flat areas of the skull. On the other hand, factors affecting the inner table such as the expansion of the normally growing brain in cases of congenital synostosis or the pathological enlargement of the brain in hydrocephalus again results in deformity of the skull. The immature skull therefore, obviously responds to positive pressure whether from within or without.

Given a normal child's skull, however that is freed from the pressure within, as a result of localized shrinkage of the brain from trauma or infection something akin to a negative pressure must take place. This new stimulus is only partially satisfied by the local collection of cerebrospinal fluid i.e., the dilatation of the homolateral ventricle with the displacement of the brain toward the affected side. The equalization of pressure is completed by a reduction in the capacity of the cranial cavity in the region of the brain lesion. This is brought about by a thickening of the skull and an expansion of the air sinuses.

If the bones are soft enough, an actual flattening or even depression of the vault on the side of the lesion may occur. If on the other hand the vault is rigid enough to withstand the unequal pressure from the two sides, the osteoblasts of the inner table are unequally stimulated to activity and a thickening of the bones of the skull over the defect results or the normal absorption of the inner table fails to take place and the thickening

follows in consequence thereof. The changes in the bone occur very slowly as evidenced by the very little thickening which was present in our two youngest patients (Cases 8 and 9) who were only 9 and 8 years old respectively although they showed the other characteristic changes. This suggests that the overdevelopment of the sinuses precedes or at least takes place at a more rapid rate than the thickening of the skull. Where the parietes of the skull are lined by the walls of the air chambers such as the ethmoidal frontal and mastoid cells the process of space elimination occurs by an expansion of these air spaces and a pneumatization of the bone beyond the usual limits of the air cells. The only air sinuses participating in this change are in the order of their importance the ethmoids, mastoids and frontals. Meanwhile the falx and the normal half of the brain respond to the same stimuli by a displacement of their unattached portions toward the defect. The pineal body which was visible in two cases, was found to be displaced to the side of the lesion in one of them (Case 7). The pathological cerebral hemisphere itself makes up for the loss of substance by a dilatation of its ventricle—a sort of unilateral hydrocephalus *ex vacuo*.

A situation much better known and in many ways analogous to the one just described for the cranial cavity is seen in the chest following chronic empyema. When closure of the cavity occurs before the lung is expanded such movable portions of the chest which bound the affected side are moved inward to fill the space usually occupied by the normal expanded lung. The intercostal spaces decrease by the approximation of the ribs to each other. The diaphragm on this side becomes elevated and the heart and mediastinal contents become displaced toward the lesion all of which produces a diminished capacity of the half of the chest which houses the collapsed lung and results in an equalization of pressure in response to altered conditions.

As the patient with infantile hemiplegia grows older the healthy side of the brain continues to develop while the affected side remains arrested. Whether due to some unexplained striving for symmetry or a stimulus to outward expansion transmitted to it from the

other side the skull on the affected side continues to grow externally although lagging behind the normal half. This necessitates correspondingly slow but continued progression of the corrective factors on the inner aspect of the skull described above until the normal growth period is at an end.

SUMMARY AND CONCLUSIONS

Nine patients with a clinical picture of infantile hemiplegia are reported with especial emphasis on the roentgenological changes occurring in the skull. The roentgenograms reveal a thickening of the cranial vault on the same side as the cerebral lesion and also an overdevelopment of the frontal and ethmoid sinuses and of the air cells of the petrous pyramid of the temporal bone. On the encephalograms there is an enlargement of the lateral ventricle on the side of the cranial lesion and sometimes of the third ventricle, and both these structures are displaced toward this side. The displacement must not be confused with that produced by tumor and the differentiation roentgenologically can be made by noting the changes in the cranial vault and sinuses described and the absence of signs of increased intracranial pressure. Coarse sulci or abnormal collections of air in the subarachnoid space may be present on the pathological side. On the other hand, owing to adhesions no sulci markings may be seen.

The association of these encephalographic findings with the thickening of the skull and the homolateral dilatation of the air cells of the sinuses is so constant that when definite, the skull changes alone without the aid of encephalography permit one to make a diagnosis of localized cerebral hypoplasia.

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THE NECESSITY FOR CONSTANT SUCTION TO INLYING NASAL TUBES FOR EFFECTUAL DECOMPRESSION OR DRAINAGE OF UPPER GASTRO-INTESTINAL TRACT

WITH COMMENTS UPON DRAINAGE OF OTHER BODY CAVITIES

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THE duodenal tube has become established as an agent of real value in the relief of distention of the upper reaches of the gastro-intestinal tract. It is more than 20 years since its use was first advocated by Westermann and Kappis in the treatment of the distention of peritonitis. Until recent years, however, the employment of the duodenal tube for this purpose enjoyed but sporadic and desultory usage. The introduction of the smooth catheter tipped (nasal) duodenal tube by Levin in 1921 and the publications of McIver and his associates establishing swallowed air as the chief offender in the causation of postoperative gaseous distention, lent considerable impetus to wider and more frequent employment of the duodenal tube in the treatment of postoperative nausea, vomiting, and distention.

In 1931 it was found at the Minnesota General Hospital that instances of acute mechanical obstruction of the small intestine of ad hepatic origin could be satisfactorily decompressed by nasal catheter suction siphonage without operation (6). Since then we have studied and tried to evaluate the mechanical and physiological factors which determine the possibilities, limitations, and efficacy of decompression of the distended alimentary canal.

The element of suction we believed and found to be a significant item in accomplishing adequate decompression of the distended intestine. It has so frequently been suggested that an inlying catheter employed as a siphon without the suction principle would achieve the same effect, that it would appear to be worth while to examine the results of these two methods of drainage. Robertson Ward of San Francisco was apparently the first to employ in connection with the inlying duodenal catheter the principle of continuous suction in treating postoperative distention.

THE MARIOTTE BOTTLE

By attaching a 'Mariotte bottle' to a duodenal tube employed as a siphon the gas as well as the fluid aspirated can be collected and measured without influencing in any manner the action of the siphon. This bottle in brief consists of two glass beakers, one of the beakers being inverted and fitting inside the other. At the base of the inverted beaker are openings through which fluid may pass. The top of the inverted beaker has two openings. One of these is used as an outlet for air when the apparatus is being set up ready for use. A glass tube passes through the other opening. The upper end of this glass tube is attached to the duodenal tube and the lower end projects down to a level with the overflow spout on the outer beaker.

By inspecting the accompanying diagram (Fig. 1) it may be seen that the end of the glass tube projecting down into the inner beaker will always be at exactly the same height as the surface of the water in the outer beaker. This fact insures the maintenance of atmospheric pressure at the end of the glass tube and simulates exactly the conditions present when a duodenal tube is used as a siphon. When the siphon with Mariotte bottle attached is to be started the inner, inverted beaker is filled with water and the outer beaker is filled up to the overflow spout. As fluid is removed from the stomach the fluid level in the outer beaker is raised and an equal quantity drains into the lower bottle. As gas is removed it rises in the inverted beaker and collects at the top where its volume may be read directly on a calibrated scale. The gas displaces an equal volume of fluid however, which drains into the lower bottle. By subtracting the volume of gas from the volume of fluid in the lower bottle the quantity

¹Edme Mariotte, French physicist and physician, born 1620, died 1684.

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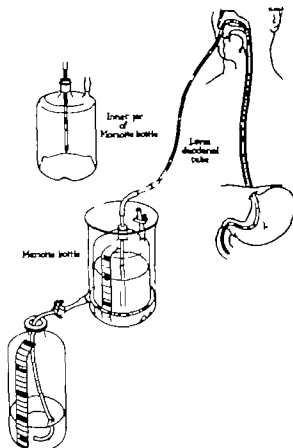


Fig. Mariotte bottle. The attachment of this bottle to a duodenal tube acting as a siphon does not interfere in any way with its action, but allows the gas as well as the fluid to be collected and measured. The overflow spout on the outer beaker is at the same height as the lower end of the glass tube, thus maintaining this point at atmospheric pressure. To set up the apparatus the tube from the overflow spout is clamped and the opening at the top of the inner beaker opened. This outer beaker is filled with water. The opening at the top of the inner beaker is closed and the clamp on the tube from the overflow spout is opened.

of fluid removed from the patient will be found.

Slightly different conditions exist when siphonage tubes draining both fluid and gas are allowed to operate with the ends submerged in water i. e., water sealed drainage. In this latter type of drainage, provided only fluid is being aspirated, it makes no difference as far as concerns the effectiveness of the system whether the end of the drainage tube is submerged in fluid or not but if both fluid and gas are expected to come through the tube then the effectiveness of the system is dimin-

ished as far as the liberation of gas is concerned by as much as the tube is submerged under fluid. A concrete example will serve to illustrate the above point. Given a duodenal tube used as a siphon with water sealed drainage. The patient's bed is approximately 75 centimeters above the floor and the end of the tube is submerged 6 centimeters below the surface of the drainage fluid which is contained in a bottle placed on the floor. As long as fluid alone fills the tube no check to its operation exists but if gas enters the system none can be expected to leave the submerged end of the tube until a pressure equal to the weight of the column of fluid above the end of the tube (6 grams) is overcome. The purpose of water sealed drainage is to prevent the retrograde passage of air into the system and hence spoiling the siphonage action. Thus retrograde passage of air will not occur if the caliber of the tube is small enough to allow the surface tension of the fluid in the tube to keep the column intact. The Mariotte bottle prevents this retrograde passage of air no matter what the caliber of the tube is and at the same time eliminates the necessity of gas being forced out under pressure which is inherent in all water sealed systems.

DETAILS OF STUDY

For this report 19 cases have been studied in detail. These cases comprise 17 cholecystectomies, 1 interval appendectomy and 1 inguinal hernia. All cases had spinal anesthesia (novocain crystals). This was frequently supplemented with nitrous oxide gas or ethylene. Four of these cases including 1 cholecystectomies and both the appendectomy and herniotomy were treated by duodenal tube siphonage without the Mariotte bottle attached to serve as a control for the remaining 15 cases, in which the Mariotte bottle was attached. In all instances a Levin duodenal tube No. 16 F was inserted through the nose into the stomach and kept in place for between 24 and 48 hours. All patients except the controls were permitted to drink two thousand cubic centimeters of clear fluids each day although no attempt was made to see that they drank that amount. The control cases were allowed as much clear fluid as they wished.

A summary of the control cases appears in Table I. While the number is too small to warrant any definite conclusions it would seem that they did very well clinically. However, there is no definite correlation between the oral intake of fluid and the fluid drainage. In addition both of the cholecystectomies were nauseated during the period of siphonage and one vomited twice. Distention was present in both of these cases.

Five patients were treated after operation by duodenal siphonage with the Mariotte bottle attached. The amounts of gas and fluid removed from the stomach were carefully measured. Their clinical course with regard to nausea, vomiting, and distention was closely followed. In 4 patients cholecystectomy was performed for chronic cholecystitis and cholelithiasis and in the other, exploration of the common duct was done at which time a stricture was repaired and a T tube inserted into the choledochus. In these cases again there appeared to be no close correlation between the intake of oral fluids and the amount reaspirated (see Table I).

Table II indicates the quantities of gas and fluid aspirated together with the oral and para-oral fluids which were given. It will be noticed also that all of these patients were nauseated, vomited, and had more or less distention. This is in marked contrast to the results obtained when patients with cholecystectomy are treated after operation with nasal catheter suction (5). The amounts of gas and fluid aspirated by suction are much larger. About two thousand cubic centimeters of gas a day is removed from the stomach and upper intestinal tract. The amount of fluid aspirated with suction depends in part on the amount of oral fluid given as well as upon the degree of inertness of the bowel present.

Two patients with cholecystectomies were treated after operation with siphonage for 2 days. The amounts of fluid and gas removed from the stomach were measured. At the end of this period suction was applied to the duodenal tube for 10 minutes. The additional amounts of gas and fluid removed were measured (see Table III). The gas and fluid obtained by suction in these 2 cases is direct

TABLE I.—CONTROL CASES

Patients treated after operation by siphonage through a duodenal tube (Mariotte bottle not attached). The quantities of fluid obtained from the stomach by a Levin duodenal tube used as a siphon together with an estimation of the clinical condition of the patient as far as nausea, vomiting and distention are concerned is shown.

| | Patient A. P. Hemil- tomy* | | Patient E. L. Appendec- tomy* | | | Patient E. T. Cholecystec- tomy | | | Patient B. S. Cholecystec- tomy | | |
|-------------------------------------|----------------------------------|------------|-------------------------------------|------------|------------|---------------------------------------|------------|------------|---------------------------------------|------------|------------|
| | 1st day | 2nd day | 1st day | 2nd day | 3rd day | 1st day | 2nd day | 3rd day | 1st day | 2nd day | 3rd day |
| Fluid drainage (c.c.m.) | 1600 | 1400 | 600 | 300 | | 20 | 3500 | 3000 | 600 | 400 | 50 |
| Oral fluid (c.c.m.) | 1400 | 2450 | 600 | 2300 | 130 | 2600 | 2250 | 1300 | 100 | 100 | |
| Subcuta- neous fluid (c.c.m.) | | | 800 | 3000 | 3000 | | 3000 | | | 3000 | |
| Intravenous fluid (c.c.m.) | | | | | | | | | 3000 | | |
| Proctology (c.c.m.) | | | | | | 1400 | 300 | 400 | 600 | | |
| Urine (c.c.m.) | 430 | 1000 | 600 | 800 | 300 | 475 | 1700 | 1400 | 850 | 000 | 750 |
| Nausea | o | o | o | o | o | xxx | o | | o | x | o |
| Vomiting | | o | o | o | | xx | o | | o | x | o |
| Distention | o | o | o | o | o | xx | xx | xx | x | x | |

*The absence of distention, nausea, and vomiting following appendec-
tomy and hemilactotomy is not unusual, and has been commented upon
elsewhere (4)

evidence of the inefficiency of siphonage as compared with suction in keeping the upper gastro-intestinal tract empty. While the amounts of gas and fluid obtained by suction in these 2 cases may appear small it should be borne in mind that such amounts represent the residue left after 48 hours of siphonage and do not include quantities of gas and fluid which may have passed into the intestine during that time and caused more or less distention and distress.

Since the purpose of our study was to test the effectiveness of the two systems of drainage more valuable information would probably be obtained if suction were instituted for a short time at different intervals during the 48 hours or if siphonage and suction were alternated at equal intervals (see Tables II, III, and IV).

Pursuing the investigation further 3 patients were treated following cholecystectomy by duodenal tube siphonage alternated with

TABLE II.—SIPHONAGE THROUGH DUODENAL TUBE

Patients treated after cholecystectomy by siphonage through a duodenal tube (Marriott bottle attached). The quantities of gas and fluid aspirated from the stomach by a Levin duodenal tube acting as a siphon together with an estimate of the clinical results obtained as far as comfort of the patient was concerned are shown.

| | Patient J. M. | | Patient F. F. | | Patient M. M. | | | Patient A. M. | | | Patient A. R. | | |
|--------------------------|---------------|---------|---------------|---------|----------------|---------|---------|----------------|---------|---------|----------------|---------|---------|
| | 1st day | 2nd day | 1st day | 2nd day | 1st day | 2nd day | 3rd day | 1st day | 2nd day | 3rd day | 1st day | 2nd day | 3rd day |
| Fluid aspirated (c.cm.) | 50 | 50 | 650 | 650 | 800 | 800 | 800 | 1200 | 1200 | 1200 | 100 | 100 | 100 |
| Gas aspirated (c.cm.) | 300 | 300 | 1700 | 1700 | 400 | 400 | 400 | 900 | 900 | 900 | 1200 | 1000 | 1000 |
| Oral fluids (c.cm.) | | 300 | 800 | 400 | 7000 | 350 | 1750 | 100 | 300 | 600 | 2000 | 2000 | 2000 |
| Para-oral fluids (c.cm.) | 2000 | | 2000 | 2000 | 300 | 1500 | 600 | 1500 | 300 | 100 | 1000 | 2500 | 150 |
| Urine (c.cm.) | 675 | 55 | 600 | 300 | 1150 | 475 | 800 | 300 | 300 | 300 | 675 | 1150 | 1500 |
| Nausea | xx | | x | | | | xxx | - | xx | | - | | |
| Vomiting | xx | | | - | - | xxx | - | - | | xx | - | | |
| Distention | | xx | | | | xx | xxx | | xx | xx | | | |
| Duration of siphonage | 23 hr. | | 27 hr. | | 45 hr. 30 min. | | | 47 hr. 30 min. | | | 25 hr. 30 min. | | |

suction at different time intervals. Three hours of siphonage were alternated with 3 hours of suction in the first case. In the 2 other cases the periods were 6 and 9 hours, respectively. The quantities of gas and fluid obtained during these periods are shown in Table IV. On a fourth patient an attempt was made to alternate suction and siphonage at 9 hour intervals but this patient experienced

so much nausea and distress during the periods of siphonage that she refused to have the suction cut off. The results in these 3 cases show that when suction and siphonage are alternated every few hours practically no fluid or gas is recovered during the periods of siphonage. This can probably be explained on purely mechanical principles and will be discussed later.

TABLE III.—SIPHONAGE WITH SUCTION AT END OF PERIOD

Patients treated after cholecystectomy by siphonage through a duodenal tube (Marriott bottle attached) with suction being applied at the end of the period. The quantities of gas and fluid obtained from the stomach during 48 hours of siphonage with a Levin duodenal tube and the additional quantities of fluid and gas obtained when suction was applied to the tube for 10 minutes at the end of the siphonage period are shown.

| | Patient E. A. | | Patient L. R. | |
|--------------------------|---------------|---------|---------------|---------|
| | 1st day | 2nd day | 1st day | 2nd day |
| Oral fluids (c.cm.) | | 800 | 1550 | 2600 |
| Para-oral fluids (c.cm.) | 400 | 1000 | 150 | |
| Urine (c.cm.) | 300 | 800 | 250 | 575 |
| Siphonage Gas (c.cm.) | 400 | 400 | 1900 | 2000 |
| Fluid (c.cm.) | 400 | 400 | 400 | 1400 |
| Suction Gas (c.cm.) | 100 | 300 | 300 | 300 |
| Fluid (c.cm.) | 50 | 50 | 150 | 150 |

Four patients were treated with siphonage following cholecystectomy. Suction was applied to the duodenal tube at intervals, the length of time usually being 10 minutes. It was applied at least once every 24 hours and more often when the patients complained because of the occurrence of nausea, vomiting, abdominal distress, or distention. The results obtained in these patients appear in Table V. If one keeps in mind the relative lengths of time the two systems were in use it is readily seen that duodenal tube siphonage is a much less effectual method of draining the upper gastro-intestinal tract than is duodenal tube suction.

RÉSUMÉ OF OBSERVATIONS

After examining the results one can not escape the impression that siphonage by means of a duodenal tube is an inefficient means of removing gas and fluid from the stomach and upper reaches of the intestine.

TABLE IV.—ALTERNATE SIPHONAGE AND SUCTION

Patients treated after cholecystectomy with alternate siphonage and suction through a duodenal tube (Mariotte bottle attached to siphon). The quantities of gas and fluid obtained by an inlying Levin duodenal tube in the stomach when siphonage and suction are alternated are shown.

| Patient A. B. | | | | | Patient H. F. | | | | | Patient A. K. | | | | |
|------------------------|--------------|-------------|--------------|-------------|------------------------|--------------|-------------|--------------|-------------|------------------------|--------------|-------------|--------------|-------------|
| Siphonage | | | Suction | | Siphonage | | | Suction | | Siphonage | | | Suction | |
| Time hrs. | Gas in c.cm. | Fluid c.cm. | Gas in c.cm. | Fluid c.cm. | Time hrs. | Gas in c.cm. | Fluid c.cm. | Gas in c.cm. | Fluid c.cm. | Time hrs. | Gas in c.cm. | Fluid c.cm. | Gas in c.cm. | Fluid c.cm. |
| 1 | | 0 | | | | | | | | | | | | |
| 2 | | | 400 | 0 | 6 | | | 875 | 15 | 0 | 0 | 400 | | |
| 3 | 0 | 0 | | | | | | | | | | | | |
| 3 | | | | | 6 | 5 | 0 | | | 0 | | | 1500 | 100 |
| 3 | 5 | 40 | | | | | | | | | | | | |
| 3 | | | 375 | 450 | 6 | | | 125 | 50 | 0 | 600 | 0 | | |
| 3 | 0 | 0 | | | | | | | | | | | | |
| 3 | | | 875 | 150 | 6 | 10 | 140 | | | 0 | | | 500 | 500 |
| 3 | 0 | 0 | | | | | | | | | | | | |
| 3 | | | 300 | 300 | 6 | | | 500 | 75 | 0 | 0 | 0 | | |
| 3 | 0 | | | | | | | | | | | | | |
| 3 | | | 100 | 0 | 8 | 0 | 0 | | | | | | | |
| 3 | 0 | | | | | | | | | | | | | |
| 3 | | | 375 | 425 | 6 | | | 750 | 350 | 0 | | | 400 | 0 |
| Total oral fluids | | | 2950 c.cm. | | Total oral fluids | | | 900 c.cm. | | Total oral fluids | | | 3400 c.cm. | |
| Total para-oral fluids | | | 2600 c.cm. | | Total para-oral fluids | | | 4900 c.cm. | | Total para-oral fluids | | | 4900 c.cm. | |
| Total urine | | | 1450 c.cm. | | Total urine | | | 1175 c.cm. | | Total urine | | | 1075 c.cm. | |
| Total time | | | 4 hrs. | | Total time | | | 43 hrs. | | Total time | | | 54 hrs. | |

Almost invariably when suction was applied to a duodenal tube which had been serving as a siphon for some hours relatively large additional quantities of both fluid and gas were obtained. These were present in the vicinity of the tube and yet were not removed by the siphonage action. It must not be concluded from this however that siphonage or water sealed drainage is equally ineffective in draining other cavities or organs. Inlying catheters used as siphons whether sealed with water or not, drain the bladder very efficiently. Observations extending over several days on 6 patients with inlying catheters for bladder drainage showed that if the catheters were properly adjusted they kept the bladders entirely empty. At least attempts to aspirate urine with a syringe at various times during the day always failed. While the muscular contraction and tone of the bladder might serve to keep the bladder empty in the usual case in atonic or paralyzed bladders the results were the same, and in such cases the

absence of urinary stasis must primarily be due to the action of the siphon.

It was possible to make some observations on the effectiveness of water sealed drainage in two empyema cavities. One of these cavities had a capacity of about 350 cubic centimeters at the time these observations were made. The drainage tube fit snugly in the chest so that there was no leak and under this regimen about 100 cubic centimeters of thin pus was being recovered daily. Over a period of about 10 days suction was applied to the drainage tube twice daily for a few moments at a time but no additional pus was ever obtained. The other cavity which was of about 260 cubic centimeters' capacity was in an 18 year old boy who had had a drainage tube inserted before entering the hospital. This tube was cut off flush with the chest wall so that water sealed drainage could not be conveniently instituted. Another tube was inserted and water sealed drainage was established. About 150 cubic centimeters of pus was obtained daily by this

TABLE V—SIPHONAGE WITH SUCTION AT INTERVALS THROUGH DAY

Patients treated after cholecystectomy with siphonage, suction being applied for short intervals during the day (Mariotte bottle attached to siphon). The quantities of gas and fluid aspirated from the stomach by a Levin duodenal tube used as a siphon are shown as well as the additional amounts obtained from the same patient when siphonage was interrupted for short intervals by the application of mild suction to the tube.

| Patient W. C. | | | | |
|-------------------|------------|-----------|------------|-----------|
| Time | Siphonage | | Suction | |
| | Gas in cm. | Fluid cm. | Gas in cm. | Fluid cm. |
| 8 hrs. 30 min. | | | | |
| 10 min. | | | 400 | 300 |
| hrs. 5 min. | | 300 | | |
| 10 min. | | | 300 | 900 |
| hrs. 1 min. | 80 | 75 | | |
| 8 hrs. | | | 900 | 300 |

| Patient M. M. | | | | |
|-------------------|------------|-----------|------------|-----------|
| Time | Siphonage | | Suction | |
| | Gas in cm. | Fluid cm. | Gas in cm. | Fluid cm. |
| hrs. 30 min. | | | | |
| 8 hrs. 30 min. | 5 | 75 | | |
| min. | | | 30 | 30 |
| hrs. 3 min. | | | | |
| 10 min. | | | 300 | 300 |
| hr. 30 min. | | | | |
| 10 min. | | | | 600 |
| hrs. 15 min. | | | | |
| 10 min. | | | | 600 |
| hrs. 15 min. | 75 | 35 | | |
| 10 min. | | | 500 | 600 |
| hrs. 30 min. | | | | |
| 10 min. | | | 400 | 300 |
| hrs. 5 min. | | | | |
| 10 min. | | | 300 | 400 |
| hrs. 3 min. | | | | |
| 10 min. | | | 300 | 300 |

TABLE V—SIPHONAGE WITH SUCTION AT INTERVALS THROUGH DAY—Continued

| Patient C. A. | | | | |
|-----------------|------------|-----------|------------|-----------|
| Time | Siphonage | | Suction | |
| | Gas in cm. | Fluid cm. | Gas in cm. | Fluid cm. |
| 7 hrs. | 400 | | | |
| hrs. 30 min. | | | 75 | 125 |
| hrs. 30 min. | | | | |
| 10 min. | | | 50 | 30 |
| hrs. 30 min. | 100 | 150 | | |
| 10 min. | | | 200 | 450 |

| Patient B. S. | | | | |
|--------------------|------------|-----------|------------|-----------|
| Time | Siphonage | | Suction | |
| | Gas in cm. | Fluid cm. | Gas in cm. | Fluid cm. |
| 7 hrs. 30 min. | 5 | 600 | | |
| hrs. 30 min. | | | 300 | 400 |
| 10 hrs. 30 min. | 400 | 300 | | |
| 10 min. | | | 100 | |
| hrs. 15 min. | 400 | 475 | | |
| 10 min. | | | 125 | 300 |

method Suction applied several times a day yielded no additional pus for the first 2 days. On the third day the amount of drainage obtained by the water sealed system decreased and large bubbles of air could be seen in the drainage system. The application of suction at irregular intervals yielded from 20 to 100 cubic centimeters of pus at each aspiration. Since this patient did not have a bronchial fistula these bubbles of gas must have come from leaks around the drainage tube. The leakage of air had decreased the efficiency of the drainage system in a marked degree.

The explanation of the ineffectiveness of siphonage in the gastro-intestinal canal and its adequacy in the drainage of empyema, of the bladder and other body cavities appears to rest solely on mechanical and physical principles. The gastro-intestinal tract, especially the stomach is unique among the cavi-

TABLE V—Continued

| SUMMARY | | | | |
|--------------------------------|--------------------|-------------------|--------------------|-------------------|
| | Patient W. C. | | Patient C. B. | |
| | Siphonage | Suction | Siphonage | Suction |
| Total time | 26 hrs. 10 min. | 4 hrs. 20 min. | 38 hrs. 20 min. | hrs. 20 min. |
| Total gas aspirated (c.cm.) | 2100 | 2600 | 1300 | 225 |
| Total fluid aspirated (c.cm.) | 415 | 800 | 550 | 625 |
| Total oral fluids (c.cm.) | 1950 | | 2100 | |
| Total para-oral fluids (c.cm.) | 5900 | | 2650 | |
| Total urine (c.cm.) | 950 | | 55 | |
| | Patient B. S. | | Patient N. M. | |
| | Siphonage | Suction | Siphonage | Suction |
| Total time | 60 hrs. 45 min. | 5 hrs. 30 min. | 5 hrs. 15 min. | 5 hrs. 30 min. |
| Total gas aspirated (c.cm.) | 0 | 55 | 100 | 2400 |
| Total fluid aspirated (c.cm.) | 2275 | 500 | 500 | 2500 |
| Total oral fluids (c.cm.) | 2700 | | 2500 | |
| Total para-oral fluids (c.cm.) | 3000 | | 4000 | |
| Total urine (c.cm.) | 900 | | 150 | |

ties of the body in that both gas and fluid are present in relatively large quantities at the same time. The duodenal tube will serve as an excellent vent for gas as long as fluid does not block it, or it will serve as an excellent siphon for fluid as long as gas does not enter the tube and break the siphonage action. Once the continuous stream of fluid in the siphon tube is replaced by sufficient air siphonage action ceases and can not re-establish itself until further fluid has accumulated within the stomach and an internal pressure has been built up high enough to force the gas out of the tube and re-establish a continuous column of fluid. Of course, a few bubbles of gas may pass through without interference but quantities of 20 cubic centimeters or more completely stop its action.

These principles would seem to be clearly brought out in those cases in which siphonage and suction were alternated at different time intervals. Practically no fluid or gas was obtained by siphonage unless it was allowed to proceed some 6 to 9 hours without interruption. During an interval of this length the intermittent effect of siphonage has an opportunity to operate. However while the internal pressure is being built up to a sufficient height to make the siphonage effective the patient becomes distressed from the accumulating fluid and gas. The patient, N. M. in Table V, demonstrates this point, plainly. Suction in this case was applied for only 10 minutes at a time and only when the patient became distressed from a sensation of fullness or from nausea. Siphonage was allowed to proceed uninterruptedly the remainder of the time. The relief experienced when suction was applied was marked in every instance.

The two cases in which suction was applied for 5 minutes after 48 hours of siphonage illustrate the fact that siphonage is not effective in draining the stomach and duodenum even if allowed to continue for a relatively long time. One must conclude, therefore, that the upper gastro-intestinal tract can not be kept empty or decompressed by siphonage alone, that it affords some relief can not be gainsaid but the addition of mild constant water suction siphonage renders drainage through the duodenal tube much more efficient.

MECHANICAL AND PHYSICAL PRINCIPLES CONCERNED IN DRAINAGE SYSTEMS

Drainage, as it is employed in medicine and surgery depends on one or more of the following principles: (1) capillary attraction, (2) contractility of, and compression by muscles and other tissues, (3) gravity, (4) siphonage, and (5) some form of constant suction. In draining the cavities of the body with the exception of the peritoneal cavity, reliance is usually placed on one or more of the 3 last, i. e., gravity, siphonage, or constant suction.

Fluid will always run from a higher level to a lower level when gravity is depended upon for drainage. Therefore it is essential that the opening through which drainage is expected to take place be located in the most dependent

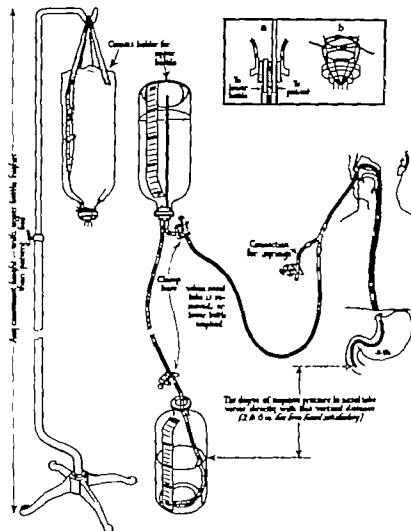


Fig. 2. Diagram of section apparatus¹ used in treating postoperative distention, nausea, and vomiting and certain cases of mechanical bowel obstruction: a special, heavy tipped (rubber of higher specific gravity) duodenal tube with perforations continued back 9 or 10 inches is employed. A Y tube connection is attached to the proximal end of the duodenal tube for purposes of irrigation to facilitate freeing it from plugs of mucus which may occasionally interrupt the suction action. A description of this apparatus and the technique of its employment may be found elsewhere (5).

position possible. A tube may or may not be used to carry off the fluid or pus from this opening. Common examples of this type of drainage are thoracotomies for drainage of empyema cavities and drainage of the bladder by a retention catheter. If tubes are employed in this type of drainage an additional factor may come into play. When tubes of large caliber are used and the surface tension of the fluid to be drained is small, drainage usually

occurs by the fluid trickling down one side of the tube leaving most of the lumen filled with air. If the drainage tube is of small enough caliber or the surface tension of the fluid great enough a continuous column of fluid will be maintained in the drainage tube. Provided these conditions exist and provided air is prevented from entering the area to be drained either around the outside of the tube or

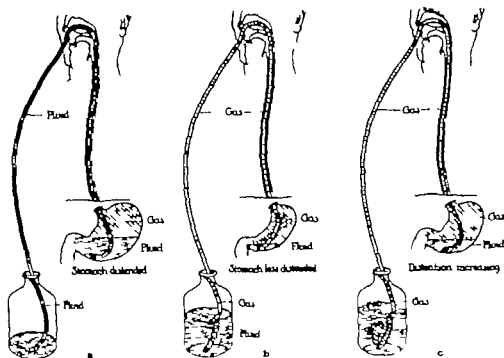


Fig. 3. Drainage of stomach by a duodenal tube acting as a siphon with water sealed drainage. a, Stomach is distended with both fluid and gas. The duodenal tube has been inserted and alphonage instituted. In a stomach with quantities of fluid and gas comparable to those indicated in the diagram considerable fluid will be aspirated. b, Distention is less. Most of the fluid has been evacuated but alphonage stopped as soon as gas entered the duodenal tube. c, Fluid and gas are accumulating in the stomach. Distention will increase until the pressure within the stomach is sufficient to force the gas out of the duodenal tube and to re-establish continuous columns of fluid.

through it, a mild constant negative pressure is developed within the drainage area. The degree of this negative pressure depends on the height of the column of fluid in the drainage tube. The vertical height of the column of fluid in centimeters is approximately equal to the negative pressure in grams per square centimeter.

In order to insure the maintenance of a continuous column of fluid in the drainage tube and hence a negative pressure in the drained area the principle of water sealed drainage is often applied. This consists of submerging the lower end of the drainage tube in water. Under such circumstances no matter what the caliber of the tube or the surface tension of the fluid the passage of air into the lumen of the tube is prevented. Such systems are particularly adapted for draining cavities or organs where only fluid is present. For this reason when it is used clinically, care should be taken to eliminate the entrance of air around the outside of the tube. As previously explained such systems develop nega-

tive pressures roughly equivalent to the vertical height of the column of fluid in the drainage tube.

Although in water sealed systems the end of the drainage tube is submerged in water fluid passing out of the tube meets with no resistance since by the action of gravity the fluid tends to seek its own level. However if gas is expected to be evacuated through the submerged tube it must be forced out under a positive pressure equal in grams per square centimeter to the distance in centimeters that the tube is submerged. Instead of creating a negative pressure in the drainage area a positive pressure is created. On this account a water sealed system of drainage is ill adapted for the evacuation of both fluid and gas from any cavity in which gas may be present in quantities of more than a few cubic centimeters at any one time. Of course a few bubbles of gas may pass through the tube without difficulty because the weight of the fluid column behind them will be sufficient to furnish the pressure necessary for their exit from the

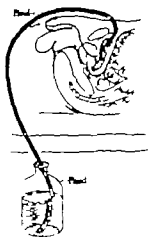


Fig. 4. Water sealed suprapubic bladder drainage in a case of benign hypertrophy of the prostate, drainage is equally effective whether or not a water sealed system is used provided the drainage tube is not of too large a caliber. If a tube of large caliber is used the fluid will run down the side of the tube allowing air to enter the system and decrease the efficiency of the drainage.

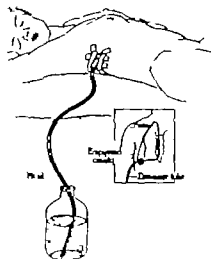


Fig. 5. Water sealed drainage of an empysema cavity. This type of drainage has been found very efficient if a bronchial fistula is not present and provided air is prevented from entering the drainage cavity around the outside of the tube.

submerged tube. At the same time however the negative pressure in the drainage cavity is decreased by an equal amount. By analogy, therefore water sealed systems are not efficient for draining the stomach or other portions of the gastro-intestinal tract.

Drainage by means of a tube used as a siphon is frequently employed clinically especially in draining the stomach and upper gastro-intestinal tract. Many people have used this method believing that its action was continuous and quite efficient. Such a contention is untenable either on theoretical grounds or on the basis of clinical experiment as indicated in this paper.

The siphon is merely a means of obviating the necessity of placing the drainage opening at the most dependent position. Its operation depends upon the existence of two vertical columns of fluid of unequal height connected at the top. A flexible tube the distal end of which is lower than the proximal end fulfills these conditions if it is filled with water. The two columns of water tend to escape through the ends of the tube and in doing so tend to create a vacuum at the top of the system. Both columns of water have the pressure of the atmosphere exerting itself on their lower ends, but since one column is longer and

therefore heavier than the other the pressure of the atmosphere becomes apparent only on the shorter column. This column of fluid therefore moves upward to fill the potential vacuum and the longer column moves downward. Thus drainage occurs and will continue as long as there is any fluid in the vicinity of the proximal end of the siphonage tube. A negative pressure then occurs at the proximal end of the tube which equals in grams per square centimeter the difference in height of the two water columns in centimeters. If gas enters the system the siphonage action ceases immediately since the difference in height of the two water columns no longer exists. Of course, as in the water sealed system, a few bubbles of gas can pass through the siphonage tube without stopping its action but a very few cubic centimeters of air or gas are sufficient to interrupt its action.

The operation of the siphon once having been stopped its action can be started again only by the re-establishment of the two unequal columns of fluid. This can be accomplished either by forcing fluid into the system from either end or by applying suction to either end and thus replacing the gas with fluid. Water or any fluid with a specific gravity approaching that of water may be

raised by siphonage to a height of approximately 32 feet.

Since gas is present in the stomach in considerable quantities from time to time it can be expected to interfere with any form of pure siphonage drainage which may be instituted in an attempt to drain or decompress it. Once stopped, siphonage may be re-established by the accumulation of fluid under a relatively high positive pressure within the stomach or by the momentary application of suction to the distal end of the tube. While time elapses before the intragastric pressure becomes high enough for the siphon to operate spontaneously, the patient is suffering unnecessary distress. For efficient decompression of a gas and fluid containing viscus or cavity such as the intestinal canal, the employment of suction is highly essential.

CONCLUSIONS

- 1 An inlying duodenal tube used as a siphon is an inefficient means of draining the upper gastro-intestinal tract
- 2 Siphonage action is highly efficient in continuous drainage of the urinary bladder and in empyema and other closed body cavities
- 3 This difference in the effectiveness of siphonage drainage of the gastro-intestinal canal as contrasted with other body cavities is dependent upon the presence of gas in the alimentary canal which enters the siphonage system and stops its action
- 4 The employment of mild continuous water suction siphonage renders drainage of

the upper reaches of the gastro-intestinal canal adequate and efficient

5 The mechanical and physical principles of water sealed and siphon drainage are discussed

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LYMPHATIC PATHOLOGY IN RELATION TO THE 'TOXIN' OF BURNS

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AMONG the less distinguished contributions to the study of any problem are the negative findings. They can be said only to mark the blind alleys of investigation and perhaps to aid others in plotting courses toward more productive endeavors.

In the reading of two scholarly papers upon the pathology incident to extensive superficial burns published now 35 years ago by Dr Charles Russell Bardeen we found what appeared to be a fertile field for investigation. And though the result of this investigation is not quite what was expected, it appears to be definite and is perhaps worth recording along with a brief review of one aspect of the question.

Bardeen emphasized certain histological changes in the lymphatic structures of the body notably the spleen lymph glands, and lymph follicles of the intestines in necropsies upon 5 children who died from extensive superficial burns. Grossly there was noted softening and enlargement of the spleen and swelling of the lymph glands and intestinal lymph follicles. Microscopically examination showed focal degeneration of the malpighian corpuscles of the spleen and swelling and central necrosis in the germinal centers of the lymph follicles. In every instance the edema was most marked at the germinal centers, and was associated with certain changes in the cells. The protoplasm often was found to be coarse and granular sometimes vacuolated, and the nuclei in some cases were represented by knotted bands of chromatin. Necrosis appearing first at the centers, seemed to spread outward from the centers of the follicles toward the periphery. At a later stage the debris was cleared away from the follicle center leaving flattened endothelial cells, with thin faintly staining nuclei. It was thought that these might be the swollen endothelial cells of the lymph spaces.

This central necrosis appeared in varying degrees. It was present in the tonsils and

quite marked in the follicles of the gastrointestinal tract. The glandular swelling was thought to be due to swelling of individual cells. Figure 1 shows reproductions of photomicrographs appearing in the original description.

Though Bardeen made it clear that proof for the following was lacking he invoked the morphology of the lymphatic unit to support this hypothesis. The central artery running into the center of the follicle, gives off capillaries that are collected into veins at the periphery. The logical route for escaping blood plasma is from within outward. The implication in the foregoing histological picture is that plasma is escaping with more than normal rapidity from the radiating capillaries. The necrosis about the germinal center suggests that the lymphocytes in this region are first subjected to the influence of the escaping plasma, and that destruction may be due to a toxic substance in the blood plasma. Figure 2 is a schematic presentation of the circulatory anatomy of the lymphatic unit, as reconstructed from the account of Calvert and from Lewis and Stoehr's text.

The total pathological picture in the case of fatal burns is rich and varied. Changes may be found in the liver kidneys, adrenals, lungs, blood brain and meninges, heart and gastrointestinal tract. Welskotten and Pack have summarized the chief contributions of this century and the reader is referred to their articles. However no observations of a more specific histological nature have appeared since Bardeen published his findings.

Anyone familiar with the voluminous literature on the subject of burns knows of the numerous attempts, in the main unsuccessful to demonstrate positively a toxin to which may be attributed the clinical course and death of the patient. The predilection for a belief in a toxin apparently arises from the clinician's bewilderment in the face of a potent factor that cannot readily be cata-

logued or estimated, and from the common use of the adjective "toxic" to describe a patient in poor condition from an unknown cause. This situation incidentally is analogous to that surrounding high uncomplicated intestinal obstruction a very few years ago.

Without inclining toward any theory of the causation of death in burns we felt that Bardeen's findings suggested that a toxin might be formed or at least be present in a high concentration at the site of these more or less specific lesions. Accordingly, the following experimental work was carried out.

EXPERIMENTAL WORK

In 9 experiments grown rabbits were anesthetized with 0.5 cubic centimeter of a mixture of dial and urethane per kilogram, given intraperitoneally. Hair was removed from one side, from shoulder to rump, by shaving or by a barium sulphide depilatory. That side was treated with the active electrode of an endotherm machine (see Fig. 3). Two animals were killed by bleeding when moribund after 36 hours—rabbits 90 and 91. The 7 remaining died at intervals of from 12 to 37 hours the anesthesia being effective throughout.

At autopsy specimens of the spleen, small and large intestine, mesenteric lymph nodes, brain, and skin were preserved for examination. These tissues, with the exception of the brain, were fixed in Zenker's fluid, imbedded in paraffin and stained with hæmatoxylin and eosin. Portions of the brain were variously fixed and stained and changes noted there may be made the basis for another report.

An extract of each spleen was made and injected intraperitoneally and intravenously into other rabbits. This was carried out in the following fashion. After weighing, the spleen was cut up into small fragments and allowed to stand overnight in 5.0 cubic centimeters of physiological salt solution in an ice box. The following day these fragments were ground in a small mortar and mixed with enough additional salt solution to give a final preparation in which there were 10.0 cubic centimeters for each gram of splenic tissue. This was then filtered through cotton, the last drops being pressed from the

TABLE I

| Rabbit A | | Duration of experiment hrs. | Pathology | | Rabbit B | | Extract c.cm. | | Result of injection |
|----------|--------|-----------------------------|-----------|------|----------|--------|---------------|------|---------------------|
| No. | Wt. k. | | Spl. | L.G. | No. | Wt. k. | I.P. | I.V. | |
| 90 | 2.0 | 36 | + | + | 90A | 2.4 | 2.5 | 3.0 | None |
| 91 | 2.0 | 36 | 0 | + | 91A | 2.8 | 3.0 | 3.0 | None |
| 92 | 2.5 | 36 | + | + | 92A | 2.5 | 3.0 | 4.0 | None |
| 94 | 3.0 | 12 | + | 0 | 94A | 2.8 | 3.5 | 4.0 | None |
| 95 | 2.7 | 30 | + | + | 95A | 3.0 | 3.1 | 3.0 | None |
| 96 | 2.4 | 18 | + | + | 96A | 3.0 | 3.0 | 4.0 | None |
| 97 | 2.7 | 8 | + | + | 97A | 2.4 | 2.5 | 2.5 | None |
| 98 | 2.9 | 37 | 0 | + | 98A | 2.5 | 3.0 | 3.0 | None |
| 99 | 2.3 | 5 | + | + | 99A | 2.1 | 4.0 | 4.0 | None |

mass through the cotton filter. Berkefeld filtration then yielded from 8 to 12 cubic centimeters of a clear pink or reddish fluid. In defense of the rather large dilution, it may be said that the proponents of the toxin theory generally are looking for a very potent substance, and that if the premise that the toxin was present in high concentration in the spleen had been correct, this dilution should have produced some effect.

After the taking of cultures, all of which failed to show growth, these extracts were injected intraperitoneally and intravenously into grown rabbits of known weight. The extract of each spleen was divided into two portions, in the first two experiments the intraperitoneal injection was made first, the intravenous 2 hours later. In the others the injections were made in the same order a few minutes apart. From 2.5 to 5.0 cubic centimeters was given intraperitoneally and from 3.0 to 5.0 cubic centimeters intravenously to each animal.

In no case were we able to observe the slightest effect of any injection.

A tabular record is submitted in order to supply details (Table I).

In the consideration of the pathological changes in the organs of the animals dying after treatment with the endotherm electrode, the states of the spleen and lymph glands seemed most pertinent to this study. As has been seen (Fig. 3), the state of the skin is indistinguishable from that produced by a superficial burn from whatever agent.

In the spleen and lymph glands edema, congestion and small hemorrhages were the most marked pathological features in all sections. Actual central necrosis of the malpighian corpuscles and lymphatic follicles as evidenced by gross disorganization recognizable under low power observation was rare. If the picture was broken up into its component parts, however after the fashion of McCrae (see below) characteristic changes may be said to have been found in the spleen in 7 instances and in the lymph glands in 8. Both were involved in the same animal in 6 cases. This was true when such criteria were selected as pyknosis of nuclei about the follicle centers, evidence of phagocytosis, hyaline deposits at the centers, fragmentation of nuclei about the centers, increase of endothelial elements. Two sections illustrating these are shown in Figure 4.

It seems fair to conclude from the foregoing that aqueous extracts of the spleens of rabbits made following treatment of the skin by endothermy are not clinically toxic when injected into other rabbits.

ALLIED OBSERVATIONS ON LYMPHATIC PATHOLOGY

Statements appearing in papers on burns earlier than those of Bardeen indicate that Andakoff Ponick, Schjerning(45) and Salvoli seem to have noticed, at least grossly some of the lymphatic tissue changes later described. From the lack of prominence given them, however one assumes that the importance of the changes was not recognized.

McCrae in 1901 paid particular attention to lymphatic structures in a series of autopsies upon persons fatally burned. Though he found the lymph glands and spleen involved frequently he considered that the changes often fell short of necrosis. He divided Bardeen's picture of the characteristic pathology into several component elements such as evidence of degeneration of lymphocytes, fragmentation of cells at the centers, phagocytosis and proliferation of large endothelial cells. In cases in which these might be found by high power observation the appearance upon low power inspection was not typical of central necrosis.

McCrae did not believe that necrosis was the basic mechanism behind these changes. He preferred to interpret the changes as essentially proliferative and affecting the endothelial cells of the reticulum and capillaries. The occurrence of similar proliferative activity of these cells was recalled in the liver shortly after accidental death in the lymph glands in peritonitis and in the spleen in myocarditis, chronic tuberculosis and cerebrospinal meningitis. He draws upon Mallory's description of the proliferative changes in typhoid fever for illustration. In this account the processes are reversed, the necroses being presumed to arise through blocking of the blood sinuses of the spleen by proliferation of endothelial cells.

However McCrae's differences with Bardeen in regard to lymphatic pathology in burns is limited to the interpretation of the picture seen by both. He, also, believes a toxin to be the cause.

In his consideration of the pathology produced by burns, Weiskotten placed the lymphatic changes among the more or less characteristic findings. In his observations, these were represented by evidence of necrosis of the central follicle cells, and were thought to be an early manifestation of the disease process. Lymphatic changes were not prominent in the specimens of Robertson and Ford, and were thought due to hemorrhagic infarction by Koliako. W. Vogt regularly found hyaline infiltration of the smaller arteries of the spleen in his preparations, but did not consider that true central necrosis was present.

Lymphatic pathology of the type described by Bardeen in superficial burns has interested other observers from time to time because of its occurrence in other disease states in which the evidence of a toxin is more concrete. A very attractive line of collateral evidence of an inferential or speculative sort is thus offered on the cause of death in burns.

Thus, somewhat similar changes were produced in 1897 by Simon Flexner with abrin and ricin poisoning. Assuming that the toxins were present in the circulating blood, Flexner suggested that a freer transudation of the toxic material occurred at some sites than at others. Parascandolo cited the similarity between certain effects in burns and those pro-

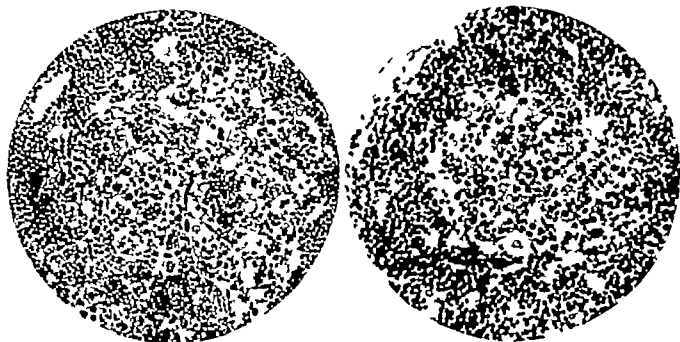


Fig. 1 Reproductions of photomicrographs appearing in Bardeen's original article. A, Left, center of lymph follicle showing well advanced area of focal necrosis. B, center of lymph follicle showing an early stage of focal necrosis.

duced by poisons, mentioning venoms as well as ricin and abrin. Welch and Flexner found approximately the same changes as those noted in burns in experimentally produced diphtheria (63) and again produced them by the injection of the toxalbumin of the diphtheria bacillus (64).

THE TOXINS OF BURNS

The cause of early death in uncomplicated superficial burns is of course, unknown at present. The sharpest difference of opinion perhaps is upon whether a toxin plays a rôle in the fatal outcome, and since that question seems pertinent to this study it will be given a brief review.

Neglecting entirely the major question of the cause of death involving as it does a consideration of several adequate hypotheses not related to toxemia, it may be well to recapitulate briefly some of the substances suggested as toxic agents. This may be interesting because of the diversity of opinions held from time to time and because of a general trend toward less specific designations. It should be stated that in some cases these substances were not definitely identified by the investigators simply comparing them with a toxin thus 'muscarin like' similar to a ptomaine, etc.

The toxin of burns has appeared to many persons in many guises. Generally speaking the toxic agent has been supposed to arise from one of three sources: first, from material ordinarily excreted which is retained under the conditions imposed by the burn, second from decomposition products of burned tissue (including blood) directly, third from interaction between two or more decomposition products.

A classification of the toxins based upon these supposed sources suggests itself but this is rendered difficult because of the complexity of some of the theories, and because more than one origin may be postulated in explanation of an hypothesis. Also instead of aggregating the hypothetical toxins and their mechanisms we have chosen simply to name the substances. The list follows:

Ammonia, Edenbuizen, ammonia or urea, Billroth, a fibrin ferment, Foà, urea, Ponfick, hydrocyanic acid, Catlano, potassium salts, Schjerning (44), ptomaine, Lustgarten, Kitjanitzin, and Ajello and Parascandolo, pyridine base, Reiss 'haemolysins and haemagglutinins' von Dieterichs, choline-like substance, Kohlrausch, methyl guanidine, Heyde, diamino acids in alkaline cleavage products, Eden and Herimann, primary and

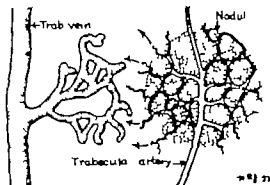


Fig. 2. A schematic presentation of the circulatory anatomy of the lymphatic unit. Reconstructed from diagram 1. Lewis and Stoehr and conforming to the account of Calvert.

secondary proteoses Robertson and Boyd peptone Olbrycht inorganic intracellular material Turck unspecified protein cleavage products Pfeiffer Fraenkel and Spiegler, Brancati Il Seung O Nishimura, and many others unspecified toxin Avdakoff Boyer and Gunnard McCrae Scholz Vaccarezza Bardeen Weiskotten Pack, Davidson Speece and Bothe Weidenfeld and many others.

A comparison of dates given in the bibliography shows that the tendency has been toward less narrow definition of the toxic principle. Today the preponderance of opinion among those who consider that toxemia is responsible for the early clinical manifestations of extensive burns seems to be that the toxin is either the product of protein decomposition or is an unknown substance. In an effort to confirm this statement and to define modern teaching on the subject we consulted twenty-six surgery texts, in English, that might be expected to consider the question. There was no mention of toxemia in seven leaving nineteen that preferred the toxemia hypothesis. Of these, six indicated a toxin but did not name the agent twelve named protein decomposition products. Only one went so far as to identify further the toxin calling it a proteose.

We do not believe that all the experimental work upon which the earlier investigators based their hypotheses can be criticized intelligently at this time. In a few instances there are obvious weaknesses of method. In others unwarranted conclusions seem to have been

drawn from the data collected. The problem is one that has not found a ready clear cut experimental approach, and it may suffice to say that in spite of experimentation earlier workers have failed to convince skeptical observers not only of the rôle of a particular substance advanced but of the existence of a toxin.

We would like to mention however some of the very interesting experiments carried on more recently by several investigators.

Weidenfeld introduced scalded skin into homologous animals subcutaneously and intraperitoneally and was able to produce death when a certain dosage by weight, was reached. Furthermore he was able to establish a direct proportion between the amount of skin introduced and the speed with which death ensued. The lethal effect was negated by thorough washing of the skin, and by long continued boiling.

Turck ground charred tissue in a mortar extracted it with water and injected small amounts of this 'solution of tissue ash' into homologous animals intravenously. In 14 animals symptoms appeared in 30 minutes or less and 7 of these died in from 10 minutes to 12 hours.

In regard to the work of these two investigators one can only say that the connection between the experimental conditions and the clinical situation in the case of the burned animal or patient does not seem entirely direct. Underhill Kapsinow and Fisk have shown that absorption is very slow and limited indeed from severely burned areas of skin (53). Histological preparations of severely burned skin show vessels that can hardly be supposed to function. We believe that Weidenfeld and Turck have shown interesting phenomena, but it may not be justifiable to conclude that these are duplicated in the organism clinically. Also the wide variation in effects of the same dosages of Turck's preparation seems to demand some explanation.

Eduard Vogt found that transplantation of the burned tissues of animals caused the recipient animals to suffer as though from a burn. Animals joined in skin-muscle and transperitoneal parabiosis both died when a lethal burn affected one of them. However

early separation seemed to protect the unburned partner in parabiosis to some extent.

Little objection has been offered to the experimental methods of Vogt and indeed our criticism is concerned more with his conclusions than with his experimental work. To be sure the control element is lacking and it not infrequently happens that intestinal pathology accounts for death in animals in transperitoneal parabiosis. However the wide variation in time between operations and experimental work should rule out this possibility unless there were unrecorded deaths in those intervals. As to conclusions, Vogt and many others whose experiments have been similar, believed he had proved more than he actually had and subsequent writers have claimed more for him than he himself claimed.

Vogt assumed simply that there was a transfer of the questioned burn toxins from one animal to the other and that this was more marked in the case of the transperitoneal parabiosis than in the skin muscle type. In regard to the division experiments he stated that the effect of separation after 24 hours of the transperitoneal union was not more effective in saving the life of the unburned partner than separation after 4 days of the skin muscle parabiosis.

In this and other similar experiments it would be more accurate to state that in the secondary animal a condition leading to death was produced or simply that 'the animal died'. Evidence of a toxin is lacking.

Robertson and Boyd made extracts of the burned skin of animals and were able to produce by intraperitoneal injection into other animals appropriate symptoms and death. Their examination of the extracts led them to believe they were dealing essentially with primary and secondary proteoses.

The work of Robertson and Boyd has been repeated in a very painstaking fashion by Underhill and Kapsinow (54) who failed entirely to confirm it. Apparently alcohol used in preparing the extracts was responsible for a large part of the effects produced.

Vacarezza, whose work appears to be more widely quoted than read, used a vascular parabiosis in his experiments. He anastomosed the femoral artery and vein of one dog



Fig. 3. Low power photomicrograph of typical section of skin (rabbit 99). Complete destruction extends into the subcutaneous tissue.

'A' with the common carotid artery and jugular vein of another dog 'B'—artery to artery and vein to vein. When the leg of 'A' thus largely isolated from the vascular system of the animal was burned, dog 'B' died while 'A' lived.

Vacarezza's arterial and venous anastomoses became thrombosed within a few hours presumably in advance of the death of dog 'B' which occurred in five and eight hours in the two experiments. The difficulty of carrying out successful anastomoses of this sort particularly where long immobilization is required makes control experiments absolutely essential. Again no necropsies are recorded and the assumption is that a more obvious cause of death in dog 'B' would have been overlooked. Finally Guptill and the author (work unpublished) have repeated Vacarezza's experiments without confirming his findings.

COMMENT

Returning for a moment to the question of lymphatic pathology it appears to have been demonstrated that somewhat similar changes appear in the spleen and lymph glands in three types of disease: burns, certain intoxications and acute infections. Two questions seem strongly suggested: first, are these pathological changes related, that is, do they represent different degrees or phases of one basic process? second if so is there an etiological factor or are there etiological factors common to all?

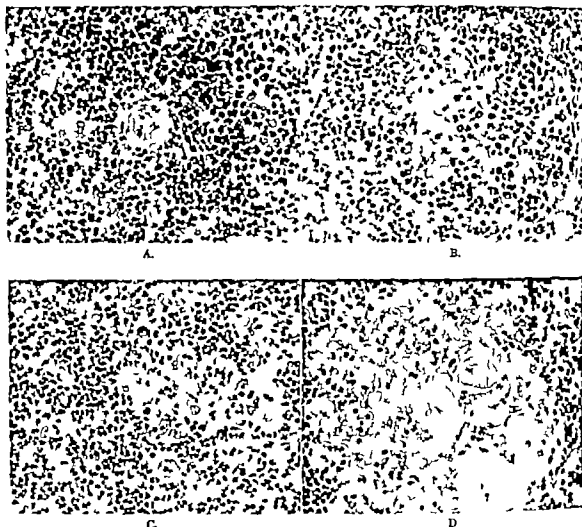


Fig 4. Varying degrees of changes produced in the germinal centers of mesenteric lymph glands and in the centers of malpighian corpuscles of the spleen in several conditions. A, Spleen of rabbit of mild degree of destructive changes, including pyknosis of nuclei about the center

some fragmentation, proliferation of endothelial cells, and phagocytosis. B, Lymph gland of rabbit of disorganization at the germinal center with evidence of degeneration of lymphocytes, phagocytosis, and proliferation. C and D, Sections of lymph gland and spleen, respectively, of patient

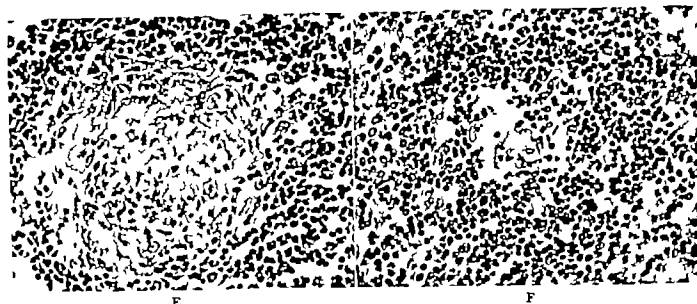
The first question can be answered only by the inferences and opinions of those who have made the observations and these indicate that the processes are related. The second since it is open to the experimental approach, may eventually be answered with more exactness.

It is a logical speculation that a common factor or common factors may run through these diverse disease states. The first that comes to mind is a toxin. The rôle of a toxin in diphtheria, scarlet fever etc. is definite, and the acceptance of a toxin as the etiological

principle in the lymphatic changes in acute infections, intoxications, and burns is prohibited only by failure to demonstrate it in the latter. For no matter how attractive the hypothesis is, the toxin of burns cannot be said to have been demonstrated up to the present.

Perhaps hyperthermia is a factor but from examination of sections of lymph glands and spleens¹ of dogs dying in hyperthermia we have been unable to establish this as a theory thus far. It should be noted that Flexner's

¹Kindly loaned by Dr. Stanford L. Warren.

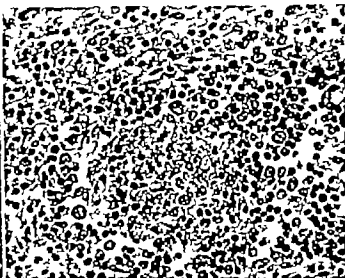


E.

F.



G.



H.

dying about a week after an ultraviolet light burn. The changes in the lymph glands were marked enough to classify as frank central necrosis. The malpighian corpuscle shows extensive central hyaline infiltration. E, Lymph gland, and F spleen from a patient dying of scarlet fever

Focal necrosis and hyaline deposits were quite constant. G, Lymph gland, and H, spleen from a patient dying of diphtheria. Focal necrosis of the germinal centers of the lymph gland and malpighian corpuscles of the spleen well advanced.

experimentally poisoned animals all showed an elevation in temperature.

Dehydration suggests itself as a common factor as do many of the physical changes in the circulating blood. The common factor may lie in some totally unsuspected mechanism or there may be none. In any case, it seems fair to hazard the opinion that the demonstration of a connecting link between burns, certain intoxications and acute infections might lead to a greater knowledge of them all. Photomicrographs are included

(Fig. 4) of sections of spleen and mesenteric lymph nodes from patients who died of ultraviolet light burn, scarlet fever, and diphtheria. All show the changes noted above to a greater or less extent.

In regard to the review of work upon toxins, contradictory reports appear, of course in any extensive experimental study. In the search for a toxin associated with burns, differences of opinion seem traceable to three factors: the lack of a pathognomonic clinical picture, the lack of a pathognomonic pathology, the lack

way afforded by these two for unwarranted conclusions—and sometimes pure speculation—from experimental results.

CONCLUSIONS

1 In the varied pathological picture produced by superficial burns, lesions in the spleen and lymph glands seem somewhat more specific than others, and the hypothesis has arisen that a potent toxin acts at these sites.

2 Aqueous extracts of the spleens of rabbits treated by an endotherm apparatus failed of toxic effect when injected into other rabbits.

3 A toxin has not been demonstrated to the satisfaction of all in burns and the theory of causation of death by a toxin cannot be said to rest upon adequate experimental work at present.

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CÆSAREAN SECTION AT THE BOSTON LYING-IN HOSPITAL

INCIDENCE, INDICATIONS, MATERNAL, AND FETAL MORTALITY—1894 TO 1931

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THE group of cases studied here consists of all the abdominal cæsarean sections performed at the Boston Lying-in Hospital prior to January 1 1932 except 69 cases which were done definitely before the age of viability for therapeutic abortion. There are 1 556 cases of which 913 were primary cæsarean sections and 643 were repeat cæsarean sections. The primary cæsarean sections are grouped according to the chief indication as follows:

- 1 Disproportion or cervical dystocia, 527 cases
- 2 Heart disease 95 cases.
- 3 Toxæmia with or without convulsions or chronic nephritis, 73 cases
- 4 Premature separation of the placenta 76 cases.
- 5 Placenta previa, 44 cases
- 6 Miscellaneous indications, 98 cases

These groups are not mutually exclusive but such overlapping as occurs is noted and the groups are defined in detail below

PRIMARY CÆSAREAN SECTIONS

1 *Disproportion or cervical dystocia* This group is composed of 527 patients who had vertex presentations and no serious complications (4 had very mild toxæmia, 2 had mitral stenosis without failure and 1 had both a mild toxæmia and mitral stenosis without failure. No deaths occurred among these 7 patients). An accurate separation of these patients into those who actually had disproportion and those who did not is impossible from a study of the records. They were all subjected to cæsarean section for the purpose of avoiding the risk of a protracted labor or a difficult pelvic delivery and therefore, represent a definite type of cæsarean section from the standpoint of indication and also of risk.

In the course of 36 years there have been rather marked changes in the incidence of this type of the primary cæsarean, in the manage-

ment of these cases and in the mortality changes which are shown in Table I

It will be noted that in recent years about the same proportion as formerly are done with out any test of labor but the average test of labor is much longer and a cæsarean section after rupture of the membranes is now regarded with comparative equanimity

The causes of maternal death in this group were sepsis 12, pulmonary embolus 2, bronchopneumonia, 2, intestinal obstruction 1, endocarditis, cerebral embolus 1. In the last 322 cases (1916-1931) there was but 1 death from sepsis

Of the 527 infants 7 were stillborn (1.3 per cent) and 17 died (3.2 per cent). Nearly all of the stillbirths occurred after long labors with no other apparent cause. (There were few autopsies.) Lest this be thought a point against prolonging the test of labor, it must be noted that since 1912 (i.e. in the last 404 cases) there were but two stillbirths both in cases sent in as emergencies in which forceps delivery had been attempted. Of the neonatal deaths 5 were due to congenital abnormalities. Of the 12 others 4 only could possibly have been associated with labor: 1, in 1910, due to 'intracranial hæmorrhage' after 4 hours of labor, 1, in 1913 due to 'asphyxia' after 46 hours of labor, 1 in 1914 due to "asphyxia" after 18 hours of labor, and 1 in 1918 due to 'intracranial hæmorrhage' after 16 hours of labor. In none of these 4 infants was autopsy done. In the past 8 years during which the length of the test of labor in these cases was markedly increased, there have been no neonatal deaths attributable to prolonged labor. A complete discussion of the relation of neonatal mortality and stillbirths to the length of the test of labor should of course, include a study of fetal results in borderline cases subjected to a test of labor and delivered through the pelvis. We have however at this time no data for such a study.

TABLE L.—SUMMARY

| | 1921-22 5 yrs | 1923-24 5 yrs | 1925-26 5 yrs |
|---|------------------|------------------|------------------|
| Total number of deliveries | 552 5 | 12,170 | 84,021 |
| Number of primary cesarean sections for disproportion or dystocia | 203 | 7 | 5 |
| Tendence per 1,000 deliveries | 3.7 | 0.3 | 6.3 |
| Proportion of low type of opera- tion (Buck or Kerr) | | 7% | 60% |
| Proportion assisted vaginally | 44% | 75% | 70% |
| Proportion done after onset of labor | 64% | 67% | 60% |
| Average hours of labor | 12 hr | 9 hr | 17 hr |
| Proportion done after rupture of membranes | 18% | 18% | 47% |
| Average hours after rupture of membranes | 7 hr | 8 hr | 12 hr |
| Deaths | 14 | 4 | |
| Mortality | 7% | 5% | |

2 *Heart disease* There are 95 cases in which heart disease was the conspicuous indication for cesarean section. Five of these patients possibly had disproportion and 3 had mild or moderate toxemia. There were 7 deaths. There are in addition 18 patients with heart disease grouped under other headings as follows: disproportion or dystocia 3; separation of the placenta 2; toxemia or nephritis 2; repeat cesarean sections 11. One of these 18 patients, a chronic nephritic, died of pelvic peritonitis and perinephric abscess. Thus the mortality would remain practically the same (7 per cent) were these patients included in this group. Of the 95 cases, 44 had no heart failure at any time. Of these 44, 1 died of sepsis. Slightly more than half of them were multiparae and all the multiparae were sterilized. In these cases the opportunity to resect the tubes seems to have been the principal reason for the cesarean section.

Of the 95 cases, 51 either had or had had definite signs of heart failure or seemed to be on the verge of failure. Six of these died, 4 of heart failure, 2 of sepsis. About 60 per cent of these patients were multiparae and 80 per cent of them were sterilized. Labor is not an important factor in the patients with failure. Only one-quarter of them had any labor at all and those had an average of 8 hours. Only one of the fatal cases had had any labor (5 hours).

The proportion of Class 1 cardinals delivered by cesarean section has decreased markedly. From 1920 to 1923, 48 per cent of them were so delivered; from 1924 to 1927, 30 per cent; and from 1928 to 1931, only 12 per cent. There are two factors in this decrease. For one thing there has been in recent years less tendency to resort to cesarean section for patients who have had no sign of heart failure and for another because of improvement in the prenatal care of our cardinals, fewer of them have heart failure.

In the group without failure there were 45 babies of whom none were stillborn, and 1 died of prematurity. In the group with failure there were 52 babies (one case of twins). One was stillborn and 11 (21 per cent) died of prematurity.

3 *Eclampsia toxemia without convulsions chronic nephritis*

a. *Eclampsia* There were 10 cases of antepartum eclampsia delivered by cesarean section. Two of these had premature separation of the placenta and are included in that group (both died). Of the 8 other cases, 2 had marked disproportion, 1 was induced by rupture of the membranes but made no progress, and 1 was admitted moribund and was delivered by cesarean section for the sake of the baby which survived. Of the 8 patients, 4 died—3 of eclampsia, 1 on the sixteenth day of pneumonia and empyema. Of the 8 infants, 1 was stillborn and 1 (weight 3 pounds, 10 ounces) died on third day in a convulsion.

b. *Toxemia without convulsions* There were 52 patients with severe hypertension and albuminuria, but without convincing evidence of chronic nephritis, who were delivered by primary cesarean section. Five of these probably had some degree of disproportion, 1 had mitral stenosis without failure. Three-fourths of them were primiparae. Six only had started in labor (average 8 hours). Three patients died, 1 of intestinal obstruction, 1 of bronchopneumonia and uremia, and 1 of postpartum eclampsia. In the group of repeat sections are 5 patients with severe, or moderately severe, toxemia. None of them died. Inclusion of these cases makes the mortality for cesarean section in toxemic cases uncomplicated by convulsions or separation of the

placenta about 5 per cent (3 deaths in 57 cases) The toxæmic patients with separation of the placenta are considered in the next group Scattered through the other groups are 21 cases with very mild symptoms of toxæmia, among which there were no deaths.

Of the 53 babies (1 case of twins), 1 was still born and 4 (8 per cent) died of prematurity

c. *Chronic nephritis* There are 13 cases with 2 deaths, 1 from uræmia, 1 from pelvic peritonitis, perinephric abscess and uræmia. In one of the fatal cases there was rheumatic heart disease Ten of the patients were multiparæ Eleven were sterilized One patient only was in labor, for 1 hour The pre dominating motive in delivering these patients by cæsaean section seems to have been the desire to sterilize the patient and to give the premature infants a better chance of survival. As a matter of fact 8 of the 13 babies died of prematurity There were no still births

4. *Premature separation of the placenta* There are 76 cases of primary cæsaean section for premature separation of the placenta and 2 cases of repeat cæsaean section in which separation had begun Of the 78 cases 42 had hypertension and albuminuria. Since this group of 42 patients shows a mortality of 21 per cent (9 deaths) they are reported in some detail. Roughly one third were primiparæ Two patients had convulsions antepartum and both died Thirty-six patients were delivered by the classical operation with 6 deaths, 2 by the Kerr operation with 1 death (in this case hysterectomy was done 7 hours after delivery), and in 4 cases the Porro operation was done with 2 deaths. Thirty nine were done under nitrous oxide gas oxygen ether anaesthesia with 8 deaths, 3 under local anaesthesia with no deaths, 1 under spinal anaesthesia with 1 death. Three fatal cases and 3 recovered cases were transfused at the time of operation One fatal case was transfused on the seventh day and 1 recovered case on the twenty-eighth day The essential facts in the 9 fatal cases are briefly as follows

1. ix para. Nephritis. Oliguria. Died on seventh day in uræmia. No autopsy

2. iv para. Toxæmia without convulsions. Died suddenly 7 hours after operation without evidence of

hemorrhage. Partial autopsy showed hemorrhages in liver and severe nephrosis.

3. ii para. Convulsions Oliguria. Died on seventh day in coma.

4. i para Toxæmia without convulsions. Died on eighth day of peritonitis Autopsy

5. i para. Convulsions. Died 4 hours after operation without evidence of hemorrhage. Autopsy showed liver necrosis.

6. v para. Toxæmia without convulsions. Died in 36 hours, anuric, twitching, apparently on verge of convulsions No autopsy

7. iii para. Toxæmia without convulsions. Suppression of urine. Died 3 hours after classical operation. No autopsy Diagnosis shock. No external hemorrhage.

8. xii para. Toxæmia without convulsions. Oliguria. Died on sixth day Sepsis and uræmia. Autopsy

9. v para. Toxæmia without convulsions. Lapa rotomy 7 hours after delivery because of suspected internal hemorrhage which was not found. Uterus removed although there had been little external bleeding postpartum. Died on third day Autopsy showed acute hepatitis and pregnancy nephrosis.

There are three noteworthy facts about this small group of patients. They have an extremely high mortality, hysterectomy is in frequent although the opportunity afforded of removing the uterus has often been advanced as an argument for delivering this type of case by cæsaean section, there are no deaths clearly due to hemorrhage There would seem to be a reasonable doubt as to whether cæsaean section is the best method of delivering these patients.

Of the 36 patients without evidence of toxæmia or nephritis, 3 died 1 of hemorrhage and shock, 1 as a result of a severe reaction to transfusion and 1 of septicæmia Two of the patients had rheumatic heart disease without failure and both survived. There were 35 classical operations and 1 Porro Nitrous oxide gas-oxygen ether anaesthesia was used in 33 cases, local anaesthesia in 2, and spinal anaesthesia in 1 All deaths occurred after classical operations under general anaesthesia.

In the toxic group, 76 per cent of the babies and in the non toxic group 46 per cent of the babies were lost because of non viability, stillbirth, or death from prematurity

5. *Placenta prævia* There are 44 cases of primary section for placenta prævia and 3 cases with placenta prævia in the group of repeat sections. Of the 47 patients 4 (9 per

cent) died. This figure is no true indication of the mortality to be expected in the treatment of placenta prævia by cesarean section because the group is so small and 3 of the deaths are due to causes which would, or should occur but rarely. One patient was moribund from hemorrhage when admitted, 1 died of hemorrhage, having bled excessively between the time of examination for diagnosis and the time when preparations for operation were completed and 1 died of peritonitis and obstruction as a result of a sponge left in the abdomen. The other patient died of sepsis. The trend in this clinic is distinctly in favor of cesarean section for placenta prævia, complete or partial, when the child is probably viable. Previous to 1928 only an occasional case was delivered by section while in the 4 years, 1928-1931 58 per cent of all the prævia cases were delivered by cesarean section.

Of the 47 babies—1 was non viable 2 were stillborn and 11 died—1 of meningitis 1 of cerebral hemorrhage 1 of cellulitis of face and 8 of prematurity. Of the 41 babies weighing 4 pounds or more 9 (22 per cent) were lost.

6 *Miscellaneous indications* This group is composed of 98 cases of primary cesarean section which do not fit into any of the other groups of primary section. In 16 cases some degree of disproportion was probably a factor. There were 5 deaths, 4 from sepsis 1 from shock and hemorrhage. The indications were as follows: previous gynecological repairs or vaginal scars 27 cases (1 death) breech or transverse presentations 21 cases (1 death) dystocia because of pelvic mass (ovarian cysts, fibroids, prolapsed kidney) 16 cases (1 death) to insure a living child because of age or previous inexplicable stillbirths, 11 cases pulmonary tuberculosis 4 cases contraction ring 4 cases previous myomectomy 3 cases pyelitis, 2 cases and 1 case each for the following indications—mistaken diagnosis of cancer of cervix patient dying of cancer of breast exophthalmic goiter diabetes double cervix and vagina perforation of lower segment by examining finger fetal distress early in labor multiple fibroids imbecility (1 death from shock and hemorrhage) carcinoma of ovary (1 death). In one case no

indication is to be found in the record. Three of these patients had mild toxæmia and 2 had mitral stenosis without failure.

Of the 99 babies (1 set of twins) 2 were stillborn and 3 died (1 of erysipelas, 1 of hydrocephalus and 1 of bronchopneumonia).

REPEAT CESAREANS

In the following discussion it must be borne in mind that the term "cases" refers to cesarean sections and not to patients. There are 643 cases of repeat cesarean section which were performed on 446 patients with 22 deaths, a case mortality of 3.4 per cent.

In 475 cases the indication for the primary section is known. Nearly 80 per cent of these 475 cases followed primary sections for disproportion or cervical dystocia. At the present time this ratio is about 50 per cent due to the increase in the number of primary cesarean sections for other conditions than uncomplicated disproportion and cervical dystocia.

In 35 of the repeat sections there were additional indications as follows: in 5 cases moderate or severe toxæmia in 5 cases mild toxæmia in 3 cases placenta prævia in 11 cases heart disease in 1 case partial separation of the placenta and toxæmia in 1 case partial separation of the placenta without toxæmia and in 3 cases rupture of the uterus. The only death among these 34 cases occurred in 1 case of placenta prævia.

The mortality of repeat sections has not diminished and in recent years has been higher than the mortality of primary cesarean section for uncomplicated disproportion and cervical dystocia. For the first 22 years it was 2 per cent (2 deaths in 84 cases) for the next 8 years 4 per cent (10 in 262), and for the last 8 years 3 per cent (10 in 397). As noted above, there were 35 cases with complications but these do not account for the higher mortality since death occurred in only 2. If vaginal examinations, labor and rupture of the membranes are important factors in mortality the repeat sections are an ideal group since in the past 16 years (559 cases) only about 1 per cent have been examined vaginally about 65 per cent have been done before onset of labor and the others on the average 6 hours after about 90 per cent have

been done before rupture of the membranes and the other 10 per cent on the average 6 hours after. What the factors may be which make repeat section a greater risk than primary section for uncomplicated disproportion or cervical dystocia it is difficult to say. The causes of death in this group were sepsis 7, shock and hæmorrhage, 7, lobar pneumonia, 4, bronchopneumonia, 2, intestinal obstruction 1, acute dilatation of heart and pulmonary oedema, 1. It will be noted that shock and hæmorrhage, which do not appear among the causes of death in group 1 of the primary sections are a conspicuous cause of death in this group of repeat sections.

Of the 649 infants (6 cases of twins), 7 were stillborn, 11 per cent, 28 infants, 4.3 per cent, died—11 of prematurity, 3 of congenital anomalies 1 of syphilis, 1 of intracranial hæmorrhage 1 of hæmorrhagic disease, and 11 of obscure causes in most cases considered as status lymphaticus.

Incidence of cesarean section. The incidence of cesarean section has been computed for the 6 year period 1894 to 1899 and for each succeeding 4 year period. The results are shown graphically in Figure 1. The basis of the computation is the total number of deliveries in the hospital and the out patient department and the results shown by the heights of the various columns are expressed in cesarean sections per thousand deliveries. The numbers above each represent the number of deliveries for the period. The black areas represent the incidence of primary cesarean for uncomplicated disproportion or cervical dystocia (group 1) the cross hatched areas represent the incidence of primary cesarean for all other indications, the white areas represent the incidence of repeat cesarean section.

The rapid and marked increase in the total incidence of cesarean section and the part played by repeat section in this increase are apparent. As a matter of fact, the total incidence would have decreased considerably in the past 12 years were it not for the fact that an increasing number of repeat sections have been done on patients who had had previous sections done elsewhere. In the last 8 years such cases account for 50 per cent of

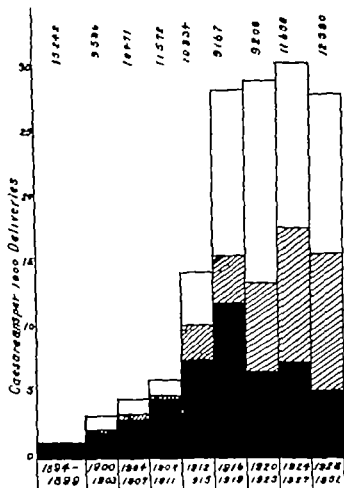


Fig. 1. Incidence of cesarean section per 1,000 deliveries. Black, primary cesareans for uncomplicated disproportion or dystocia. Cross-hatched, primary cesarean for all other indications. White, repeat cesareans.

the repeat sections. On the other hand, in recent years a smaller proportion than formerly of the patients on whom we did primary cesarean sections have returned to us for subsequent deliveries. On the whole, therefore, the total incidence is not as useful as the incidence of primary section in showing the trend in the use of the operation. Figure 1 shows that for 16 years the incidence of primary section has remained close to 16 per thousand owing to the increasing use of the operation for indications other than disproportion or cervical dystocia.

The significance of the black areas of Figure 1 is obvious when the type of case represented here is recalled. They show the incidence of the sections for which there was no indication whatever except actual cephalopelvic disproportion, or suspected or alleged disproportion, or the fear of protracted labor. It is not

reasonable to suppose that the incidence of actual disproportion in the clinic population would give a curve like this. Therefore, we attribute the marked decrease in this type of cesarean to greater discrimination in the selection of cases for section. In recent years this selection has been accomplished mainly by the increasing use in doubtful cases of a thorough test of labor even after rupture of the membranes. There is as yet no evidence of an adverse effect on the mortality.

Mortality The mortality rates for each of the groups have been stated. Most of these groups are so small that the rates have little significance by themselves. There are, however, some general conclusions in regard to the mortality of cesarean section which are valid.

The mortality of the whole group of 1556 cases is 4.9 per cent. Investigation shows that the general mortality has changed but little in the course of years. In the first 328 cases (1894-1915) it was 6.1 per cent. In the next 529 cases (1916-1923) it was 4.5 per cent. In the last 699 cases (1924-1931) it was 4.5 per cent. The mortality has remained at this high figure because of the increased use of the operation in conditions which make the patients bad surgical risks, as is shown by considering the last 699 cases. Of these, 448 were either repeat sections or were primary sections for uncomplicated disproportion or cervical dystocia. These cases had a mortality of 2.2 per cent. The other 251 cases of primary section showed a mortality of 8.8 per cent. Thus there is no point in computing the mortality of cesarean section in general. For the same reason there is little point in directing attention to the relatively high proportion of maternal deaths which follow cesarean section a fact which simply indicates how extensively cesarean section is used for delivering patients who are gravely ill with heart disease, kidney disease, pre-eclamptic toxemia, or other disease. Cesarean section may or may not be the best way of delivering such patients but it will inevitably show a higher mortality in these cases.

Primary cesarean section on healthy patients now has a mortality in the neighborhood of 1 per cent. It should always be

remembered however, that 1 per cent is a high mortality compared to the risk of easy pelvic delivery in similarly healthy women.

SUMMARY

From 1894 to 1931 inclusive, 1556 cesarean sections were done at the Boston Lying-in Hospital, with a mortality of 4.9 per cent. Of these, 913 were primary cesareans. Of all the primary sections 58 per cent, 527 were done for disproportion or cervical dystocia without other indications or complications. At the present time only about one third of the primary sections are for this indication. Of the other primary sections 95 were done chiefly for heart disease, 73 for toxemia or nephritis, 76 for premature separation of the placenta (including some toxic cases) 44 for placenta prævia, and 98 for a variety of miscellaneous indications. The use of cesarean section for cardiac patients who have not had heart failure and have no other indication has diminished. The use of the cesarean section for placenta prævia has increased. The incidence of primary cesarean section for disproportion or cervical dystocia has decreased from a peak of 12 per thousand deliveries 15 years ago to a level of 5 per thousand deliveries during the past 4 years indicating a much more conservative attitude toward this type of cesarean section. The total incidence of cesarean section has been close to 30 per thousand deliveries for 16 years.

About one-half of the cesarean sections now are repeat sections. Although fewer cesarean sections are done now for suspected disproportion the incidence of primary section remains at about 16 per thousand because of the extension of the indications for cesarean section. The mortality of primary section for uncomplicated disproportion or cervical dystocia is now about 1 per cent. The mortality of repeat cesarean section is now about 3 per cent. That the mortality in general is now about 4.5 per cent is due mainly to the high death rate in primary section on patients with impaired cardiac or renal function. The infant mortality varies according to the group considered. Following primary section for disproportion it has been about 2 per cent for

the past 16 years, about half the deaths being due to congenital anomalies. In the group of repeat sections during the same period it has been nearly 4 per cent, the increase being due mainly to the larger number of premature infants delivered by repeat caesarean section.

In the groups of toxæmic, nephritic, and cardiac patients there is a high neonatal death rate due to prematurity, which raises some doubt as to whether caesarean section is any better than pelvic delivery for these premature infants.

GYNECOLOGICAL ASPECTS OF THE ETIOLOGY AND TREATMENT OF CHRONIC MASTITIS

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THE painful, diffusely swollen or nodular breast is one of a wide variety of conditions which now pass under the name of chronic mastitis. This special form of breast disease is apparently very common, for with a few exceptions the 102 cases of this report were admitted to the Breast Clinic of the Memorial Hospital within a period of only 2 years.

CLINICAL ASPECTS

With the present concentration of interest upon the circumscribed lump and its relation to cancer, there has been a neglect of the diffuse non-surgical forms of chronic mastitis with their interesting symptomatology which is often suggestive of an underlying constitutional disorder. These aspects appear to have been formerly better understood, as is indicated by Astley Cooper's description of "the irritable tumors of the breast," in which he noted particularly the intermittent radiating character of the pain, its exacerbation before the menstrual period, and its special frequency in young women of excitable temperament and abnormal menstrual function. Study of the histories of the present cases shows the accuracy of these observations.

The painful breast is a disorder of relatively young women and its age incidence definitely lower than that of the circumscribed forms of chronic mastitis (Table I).

The proportion of married patients is that to be expected in women of such ages but the frequency of sterile marriage is a little high (Table II).

The presence of pain of more or less severity was the basis for the selection of these patients, for although in all but five abnormalities in consistence were thought to be present, the normal breast is too variable a structure for a dependable diagnosis to be made upon what appear to be minor degrees of increased nodularity. This pain was, as a rule, bilateral and characteristically intermittent, appearing a variable number of days before each menstrual period and improving rapidly after the onset of bleeding. Particularly in the older women, however, frequent exceptions to this rule occurred and the pain was sometimes largely unilateral and nearly constant. Radiation of the pain to points outside of the breast, such as arm, shoulder and chest wall was present in about a fifth of the cases (Table III).

Beside this cardinal symptom, the following miscellaneous complaints were also noted: temporary but marked premenstrual swelling in 21 and a constant enlargement of one or both breasts in 14 cases, the intermittent appearance of a premenstrual lump in 7 and the presence of a constant lump in 11 cases, secretion from the nipple in 8 and bleeding in 1 case.

The physical characteristics of the breast tissue varied from a practically normal consistence to a nodularity so definite as to require consideration of surgical excision. In the great majority, however, the breast was regarded as moderately abnormal due to the presence of diffusely scattered nodules or of zones particularly in the outer quadrant where faintly

TABLE I—AGE INCIDENCE

| Age in years | Cases |
|--------------|-------|
| 15 to 20 | 8 |
| 21 to 30 | 16 |
| 31 to 40 | 45 |
| 41 to 50 | 16 |
| Total | 75 |

TABLE IV—CONSISTENCE OF BREAST TISSUE

| | Cases |
|--------------------------------------|-------|
| Normal consistence | 8 |
| Operational "tumors" | 37 |
| "Mastitis" in certain quadrants only | 42 |
| Circumscribed nodules | 15 |

TABLE II—MARITAL STATUS AND FERTILITY

| | Cases |
|---------------------------|-------|
| Single | 19 |
| Married—no pregnancies | 4 |
| Married—miscarriages only | 3 |
| Married with children | 27 |
| Total | 53 |

TABLE V—TYPE OF PREVIOUS TREATMENT

| | Cases |
|------------------------------|-------|
| Excision of chronic mastitis | 13 |
| Excision of fibro-adenoma | 7 |
| Early therapy of breast | 1 |
| Ductectomy | 3 |
| Postpartal inflammation | 3 |
| Others | 3 |

TABLE III—CHARACTERISTICS OF BREAST PAIN

| | Bilateral | Unilateral |
|---------------|-----------|------------|
| Pre-menstrual | 45 | 16 |
| Constant | 13 | 6 |
| Irregular | 13 | 6 |

outlined masses could be distinguished from the softer remainder of the breast (Table IV).

When examination was made during the time of the exacerbation of symptoms, the breast was often found to have a tense, swollen appearance not dissimilar from that of early pregnancy and tenderness was often pronounced. No size or shape of breast appeared especially predisposed to the disease. A marked asymmetry often of recent origin however was common (18 cases) and when this was present symptoms were almost invariably more severe in the larger breast.

PATHOLOGY OF THE PAINFUL BREAST

The pathological basis for this disease is obscure since tissue is rarely available for study. In the cases in which pain and diffuse swelling are the predominant features it is probable that the histological changes consist only in an exaggeration of the variations found in the normal breast in relation to the menstrual cycle. These normal cyclical changes have remained however a matter for dispute, and it is undecided whether actual epithelial proliferation or merely a functional reaction occurs before each period (Rosenburg Dieckmann Moszkowicz). For the histology of the painful, moderately circumscribed nodules Sebening has described a state of permanent hyperplasia of the epithelium of the breast lobule in which the normal intermenstrual regression as described by

Rosenburg fails to occur. He contrasts this condition with the usual histologically recognized forms of chronic mastitis but gives the opinion that transitional forms probably occur and that the epithelial proliferation of the painful nodule may be the precursor of typical chronic mastitis.

That the painful breast is related to several types of new-growth of mammary gland is strongly suggested by study of the present group of cases. In 20 patients previous breast operations had been performed for localized chronic mastitis or fibro-adenoma (Table V). The cases with a recently developed but constant enlargement of one or both breasts suggest also a connection with the so called massive hypertrophy. An immediate relation to cancer is doubtful although in 3 cases observed in the clinic a preliminary error in diagnosis was made when a small malignant tumor was concealed by a diffuse thickening in the outer quadrant which had developed in association with the symptoms of bilateral pre-menstrual pain and swelling so typical of the benign disease.

ETIOLOGY

By different previous writers the painful breast has been attributed to trauma or inflammation or regarded as a neuralgia or an hysteria, or as a sympathetic response to a primary uterine or ovarian disorder.

The history of a single injury is rarely given (Table VI) but considerable importance has been attached by several writers to the more continuous forms of trauma due to special types of clothing (Snow Wittbauer Glass) or the repeated minor injuries of a certain occupation (Morgan D'Anna). That the constant traction of the heavy pendulous breast may

TABLE VI.—CASES ASCRIBING ONSET OF PAINFUL BREAST TO DEFINITE INCIDENT

| | Cases |
|------------------------------|-------|
| Physiological change | |
| Puberty | 2 |
| Marriage | 3 |
| Menstruation | 4 |
| Childbirth | 7 |
| Menstrual change | |
| Change in type of periods | 30 |
| Onset of dysmenorrhea | 2 |
| Pelvic disease | |
| Onset of pelvic inflammation | 3 |
| Operations on adnexa | 6 |
| Hysterectomy | |
| Local condition | |
| Breast operation | 3 |
| Discovery of lump | 2 |
| Trauma | 3 |

*Of these 1 are listed with some other incident also.

TABLE VII.—MENSTRUAL TYPES AT TIME OF FIRST OBSERVATION

| | Cases |
|-------------------------------------|-------|
| Summary | |
| Normal in periodicity and duration | 34 |
| Abnormal in periodicity or duration | 68 |
| Periodicity | |
| Normal | 57 |
| Short cycle—33 days or less | 20 |
| Long cycle—33 days or more | 1 |
| Irregular | 2 |
| Duration | |
| Normal | 55 |
| 8 days or more | 4 |
| 5 days or less | 27 |
| No cycle | |
| Amenorrhea | 10 |
| Continuous bleeding | 2 |

be an important pain producing factor is shown by the relief which is afforded by proper support (Farrar, Terrillon). In spite of the implication in the term chronic mastitis inflammation is probably not a primary factor although one writer (Glass) maintains his belief in the inflammatory character of certain breast nodules. A less immediate but more demonstrable relationship to inflammation may be found for the pain arising in the scars of incisions for puerperal mastitis (Vignard). The existence of these exciting agents must all be borne in mind for the proper diagnosis of breast pain.

A confusing aspect of the disease is the nervous and mental element which is very prominent in some cases and may make itself apparent in one of three ways. (1) The excitable temperament of the patients has been emphasized by several writers (Cooper, Broca, Snow) and some have even committed themselves to the term, "the hysterical breast" (Michard). Corroboration of their views is found in the alleged development of breast symptoms after a psychic shock (Féré) or during a period of special nervous tension (Rosenthal). Further evidence of a nervous instability is found in the associated symptoms of nervous disorder frequently observed in these patients, such as palpitation and precordial pain (Wewer), dysmenorrhea (Dietrich and Frangenheim) and various gastrointestinal disorders (Cooper). (2) Suggestion appears often to play an important rôle for in many cases breast pain will long persist after

a trivial injury, or will begin simultaneously with the discovery of a minute or merely fancied lump or follow the excision of a small benign tumor. An increasingly fertile source of breast pain is now the fear of cancer, particularly in women who have witnessed the course of the disease in a member of their family. (3) The frequent radiation of the pain to points beyond the breast and the occasional limitation of the tenderness to the skin instead of the parenchyma of the breast has led to the concept of the pain as a neuralgia (Terrillon, Rosenthal, Witthauer). The view is supported by the alleged existence of fixed points of tenderness (Valleix) and by the rare association of breast pain with herpes zoster (Alfter) and tabes dorsalis (Preuss and Jacoby).

The striking increase in the severity of the symptoms before menstruation has led many writers to search for evidence of uterine or ovarian abnormalities. The older writers such as Cooper and Velpeau were very positive in their belief that pain in the breast was associated with disordered in particular scanty or delayed, menstruation, and subsequent writers have adhered to this belief (Copland, Witthauer, Rosenthal, Miller).

Beside the abnormalities of menstruation organic pelvic disease has been referred to as the cause of the painful and nodular breast and one finds mentioned in the literature such diverse conditions as the following malpositions of the uterus (Hastrup, Ayler, Miller), developmental defects (Miller, Snow), hypertrophy of the cervix (Copland), inflammations

TABLE VIII—TYPES OF LACTATION

| | Cases |
|--|-------|
| Children weaned | 47 |
| Lactation all normal | 20 |
| Lactation all deficient (Less than 6 months) | 7 |
| Some lactation normal, some deficient | 8 |
| No lactation | — |

TABLE IX—INTERVAL BETWEEN BIRTH OF LAST CHILD AND ADMISSION TO BREAST CLINIC

| | Cases |
|----------------|-------|
| Under 3 years | — |
| 3 to 5 months | — |
| 5 to 1 year | 4 |
| 1 to 2 years | 4 |
| Over 2 years | 3 |
| No information | 7 |

TABLE X—SUMMARY OF PELVIC LESIONS

| | Cases |
|------------------------------------|-------|
| Normal pelvis | — |
| No examination | — |
| Normal examination | 16 |
| Pelvic tumors | — |
| 1 uterine mass | — |
| 1 set of ovaries | — |
| Enlargement of corpus | — |
| Displacements and lesions | — |
| Retroposition or prolapse | 4 |
| Retroposition and cervical lesions | — |
| Cervical lesions | 4 |
| Pelvic inflammation | — |
| 1 broad ligament-ovarian | 7 |
| Parametritis, pelvic congestion | 3 |
| Previous pelvic operations | — |
| 1 hysterectomy | 4 |
| Operations on adnexa | 9 |

(English) fibromyomata (Miller) tumors of the ovary (Giordano Muellerheim) and persistent corpora lutea (Samuel Leriche). Many other writers, although less specific, have listed the search for pelvic lesions as one of the primary steps in the treatment of the painful breast or have reported improvement after the cure of gynecological disease.

ETIOLOGICAL EVIDENCE FROM THE PRESENT CASES

In 66 of the cases of the present study it was possible either by the patient's own report or by a study of her history to assign the onset of the breast pain to a special incident in her life. Except in the case of pelvic operations where a 2 year limit was used the pain in the breast began within a few months after the various events, accidents, or physiological changes which are noted in Table VI. The

TABLE XI—PATHOLOGY OF OVARIES AS NOTED AT OPERATION

| | Cases |
|----------------------------|-------|
| Normal | — |
| No ovary | — |
| Normal | — |
| Abnormalities in size | — |
| Both large | — |
| Both small | — |
| One small | 4 |
| Cystic abnormalities | — |
| Single cyst | 3 |
| Multiple microcysts | 3 |
| Large cystic corpora lutea | — |
| Inflammation | — |
| Salpingo-oophoritis | 3 |

great frequency with which changes in the type of menstruation are followed by the onset of breast pain is noteworthy.

Analysis of the menstrual types in these patients showed that a large percentage were suffering from some abnormality at the time of their application to the clinic for relief of breast symptoms (Table VII).

The history of lactation among the parous women showed slight evidence of a deficient breast function (Table VIII).

In view of the relative youth of these patients it was striking to find that at least 90 per cent of the previously fertile women had had no child for at least 3 years and in the great majority the interval was much longer.

Subsequent search for the reason for this secondary infertility among 55 married women with breast pain indicated that sterility was rarely the cause and that the use of contraceptive measures of a type notoriously prone to produce pelvic congestions and nervous disorders in women was the rule (Table IX).

The rôle of abnormalities of the sexual function in the production of breast symptoms has already received some attention in the literature. Samuel has briefly described several cases of mastodynia and secretion from the nipple resulting from abnormal breast stimulation and in the German writings there is recurrent reference to the occasional painful swelling of the breasts in adolescent males which has been ascribed to masturbation (Glass, Rosenthal, Wittbauer de Quervain). Dickinson, who has observed certain cases of chronic mastitis over a period of many years and diagrammatically recorded in great detail

TABLE XII—EFFECT OF VARIOUS TYPES OF TREATMENT

| | Total | Cured | Improved | No change |
|-------------------------------------|-------|-------|----------|-----------|
| Simple observation | no | 4 | 11 | 3 |
| Observation through pregnancy | 3 | 3 | | 0 |
| Observation through menopause | 3 | | 0 | 1 |
| Gynecologic operation | 10 | 6 | 9 | 1 |
| Non-operative gynecological therapy | 8 | 8 | 3 | 1 |
| Irradiation of ovaries | 13 | 8 | 4 | 1 |
| Ovarian extracts by mouth | 39 | 7 | 1 | 11 |

the fluctuations in the size of the nodules also believes that self excitation may be an important causative agent. No systematic attempt to pursue the subject further has been made but without special effort enough evidence has accumulated from several cases to indicate that research in this obscure field might yield important information upon the cause of various forms of breast disorder.

Pelvic examination on these patients yielded a diversity of lesions in general similar to those referred to by Miller. All of the conditions listed in Table X were very definite and with the exception of 8 uncomplicated, symptomless retroversions and the cases with histories of previous pelvic operations were such that some form of coincident gynecological therapy was to be recommended.

The chief additions to the pathology of the pelvic organs afforded by the 16 gynecological operations performed after the onset of the breast symptoms, concerned the ovaries. These were observed by the writer in only 10 instances and in the other cases data depend upon the reports of other operators.

These findings offer no satisfactory explanation of the breast pain. Both the cysts and the large corpora lutea are interesting but of doubtful significance owing to their general frequency. To the number of cases with cystic ovaries must perhaps be added however the 9 cases complaining of breast pain after hysterectomy. The relative frequency of this type of case is in itself striking. In all of the 9 cases adequate information could be obtained to prove satisfactorily that one or both ovaries had been preserved. That small cysts may develop in the retained ovaries after hysterectomy is recognized clinically (Vineberg) and has been demonstrated on certain animals (Lundig Zimmermann). The improvement in breast symptoms when these

TABLE XIII—EFFECT ON BREAST OF OPERATIVE TREATMENT OF PELVIC LESIONS

| | Cured | Improved | No change |
|---|-------|----------|-----------|
| Operations in which fibroids were removed | | | |
| Hysterectomy bilateral salpingo-oophorectomy | | 1 | |
| Hysterectomy unilateral salpingo-oophorectomy | 0 | | 0 |
| Hysterectomy | 0 | | 0 |
| Myomectomy suspension, unilateral salpingo-oophorectomy | 0 | 1 | |
| Myomectomy suspension | 0 | | 0 |
| Myomectomy | 0 | | 0 |
| Operations, chiefly for uterine malposition | | | |
| Suspension, unilateral salpingo-oophorectomy | 0 | | 0 |
| Suspension | 0 | 1 | 0 |
| Operations chiefly for chronic inflammation | | | |
| Bilateral salpingectomy unilateral oophorectomy | 0 | | 0 |
| Bilateral salpingectomy | 0 | 0 | 0 |

TABLE XIV—EFFECT ON BREAST OF NON OPERATIVE PELVIC TREATMENTS

| | Cared | Improved | No change |
|--|-------|----------|-----------|
| Pelvic inflammatory disease | | | 0 |
| Parametritis, pelvic congestion, dyspareunia | | 3 | 0 |
| Cervical erosion, endocervicitis | 0 | | |

TABLE XV—EFFECT OF TREATMENT BY OVARIAN SUBSTANCE

| | Cared | Improved | No change |
|------------------------------|-------|----------|-----------|
| Young single women | | 3 | 3 |
| No significant pelvic lesion | | 7 | |
| Previous pelvic operation | 3 | | 3 |
| Definite pelvic lesion | 3 | 7 | |

retained ovaries were treated by X ray represented perhaps the most striking therapeutic result that was observed in any of these cases.

SUMMARY OF CAUSES

The exacerbation of symptoms before the menstrual periods suggests an endocrine basis for the painful nodular breast. The evidence of a frequently disturbed menstruation and the relief afforded by X ray treatment of the ovaries favor this view. A consistent pelvic lesion is not however, found. A few cases with small ovarian cysts alone offer a logical explanation of the symptoms on the basis of a disorder of the ovaries. For the other cases the patients with fibroids with retroversions or lacerations or with parametritis and inflammation of the adnexa, no single lesion except the vague condition implied by the term chronic pelvic congestion can be universally applied. If these pelvic lesions are the basis of the breast disorder, the mechanism through which the breasts are affected remains undetermined.

TREATMENT

The 102 cases of the present report have been treated by one of five methods now to be described. The average period of observation after the beginning of treatment was 10 months. The success of treatment as shown in Table VII was determined chiefly by the effect upon the symptom of pain since minor variations in the consistence of the breast offer too great a temptation to the optimistic therapist and are certainly of no value unless comparative observations are made in the same phase of the menstrual month. When unmistakable changes in the physical character of the breasts occurred these will be referred to.

Group 1. Observation alone. The 30 cases observed without treatment over a period of some months demonstrate that the breast symptoms have a marked tendency to spontaneous improvement which makes difficult the evaluation of any special form of therapy. Subdivision of these cases (see Tables XVI, XVII) shows only that in the group of single women under 30 years of age the symptoms were especially persistent.

The two small groups of cases observed either before and after pregnancy or before and after the menopause demonstrate the relatively profound effect of physiological processes as compared with artificial therapeutic agents. In these cases the disappearance of nodules and softening of the breast were unmistakable.

Group 2. Operation. The results of operative treatment tend to confirm Miller's statement that improvement in the breast may be expected after myomectomy, the correction of displacements, and the cure of adnexal disease. The single complete failure in this group was in a case in which the operation failed also in the control of the uterine bleeding for which radium was subsequently employed.

Group 3. Non-operative gynecological therapy. The 8 cases of this group were essentially patients with chronic pelvic inflammation of gonorrheal origin and those with diffuse pelvic tenderness due to parametritis from cervical lacerations or infections. The types of therapy were simple pelvic diathermy, cauterization of the cervix or a course

of tampon and douche treatments. The tendency to improvement here also appears to be slightly greater than for the observation group.

Group 4. Radiation of ovaries. The readily demonstrable improvement in chronic mastitis after the normal cessation of the periods led to the consideration of the artificial menopause as a means of treatment. The radical character of this procedure made it applicable only to certain cases and the 13 of this report fall into one of three definite groups: (1) women over 45 or those over 40 in whom the onset of the menopause is already suggested by irregularity of the periods; (2) women in whom the uterus has been removed; (3) women with coincident pelvic disease which itself requires radiation.

The results of treatment by irradiation of the ovaries were convincing and a complete disappearance of breast symptoms was attained in 8 of the 13 cases. This improvement was the more striking since the most marked examples of constant tenderness and breast swelling were found in the patients treated by this means. Subsidence of swelling and symptomatic relief began within a few days of the first treatment. The only complete failure among the radiated cases was in a woman suffering from a localized breast pain whose sister had died recently of cancer and who was treated probably illogically by radiation of the ovaries 4 years after her last menstrual period.

At first the X-ray dosage was calculated to produce complete cessation of the ovarian function. In 5 of the later cases, in an attempt to avoid the troublesome symptoms of the menopause, smaller doses were given. Definite improvement in breast symptoms in 2 cases followed a single high voltage treatment of 200 r units without the production of the distressing vasomotor symptoms. In 3 cases treated by relatively light irradiation there was noted after a lapse of several months, a partial return of breast symptoms which in 2 cases was very slight and in 1 was successfully treated by a second administration of X-rays to the ovaries.

The cautious extension of the principle of small doses of X-rays to the ovaries of some-

what younger women if they intend no further children, is to be considered

TREATMENT BY OVARIAN SUBSTANCE

Since the time of Cooper attempts have been made to influence the breast condition through the correction of the disturbed menstrual function. Cooper himself recommended iron and hot baths. Velpeau proposed the application from time to time of a few leeches to the vulva. More recently favorable reports have been made upon the use of organ extracts (Schweitzer Bainbridge Lasser Cutler).

The extremely favorable report of Cutler upon the use of ovarian residue by mouth led us to an extensive trial of ovarian preparations. With the relation of the exacerbations of pain to the periods in mind, tablets of ovarian residue or of whole ovarian extracts were prescribed in daily doses of 15 grains during the 10 days before the onset of each expected menstruation.

The results as summarized in Table XV show that the percentage of cured and improved cases was practically the same as in the group observed without treatment for a like period. To this practical demonstration of failure the point must be added that the use of ovarian substance or residue is quite empiric since no deficiency in hormone has yet been demonstrated. Furthermore, were a deficiency present the type of substance used in this and previously reported series must now be regarded as utterly inadequate significantly to increase the patient's supply of ovarian hormone. The administration by hypodermic injection of follicular and anterior pituitary hormones is now being tried in the clinic.

SUMMARY OF TREATMENT

1 Chronic mastitis of the type characterized by pain, ill defined nodules and diffuse swelling has a marked tendency to spontaneous improvement.

2 Following the physiological changes of pregnancy or the menopause improvement may be especially marked.

3 The elimination of pelvic lesions either by surgical or non-surgical treatment is followed by a somewhat greater percentage of

cures than is observation alone. When important pelvic lesions exist their correction should be the first step in the treatment of diffuse mastitis of the type under consideration.

4 Irradiation of the ovaries either with the production of an artificial menopause or by a smaller dose is very effective although applicable only to certain cases.

5 The administration by mouth of the older forms of ovarian extract or residue is useless. Trial of more potent modern preparations of follicular and anterior pituitary hormones is indicated in the cases in which breast symptoms are associated with disturbed menstruation.

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CHRONIC CICATRIZING ENTERITIS

REGIONAL ILEITIS (CROHN) A NEW SURGICAL ENTITY¹

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"NON SPECIFIC granuloma," "infectious granuloma," and "benign granuloma of the intestine" as used in the American surgical literature and "intestinal phlegmon" or inflammatory tumor of the intestine" as used in European literature bring to the mind and memory of the surgeon the recollection of the occasional case of an intestinal tumor encountered in his practice that defied classification. It was neither neoplastic nor of specific bacterial origin and its etiology pathology treatment, and prognosis have been the source of much conjecture and concern.

Study of the surgical literature in particular that literature devoted to clinical reports and surgical society discussions reveals an unusually large interest in discussions of this type of tumor which at the operating table so closely simulates malignancy, but is ultimately proved to be of an inflammatory nature. Such tumor like processes are reported as being found in any part of both the small and large intestines. They are recognized as not being carcinoma, lymphosarcoma tuberculosis Hodgkin's disease, or diverticulitis and the multiplicity of the various sites in which they occur with the varying clinical manifestations has to date produced a confusion which has prevented any proper clear cut description of these lesions.

From this confusion of ideas concerning rare benign intestinal lesions Crohn Ginzburg and Oppenheimer have separated a group which appears to answer all the requirements of a specific clinical entity with well defined pathology and clinical characteristics to which they have proposed the name regional ileitis.

Regional ileitis as defined briefly by these writers is a disease of the terminal ileum affecting mainly young adults and char-

acterized by a subacute or chronic necrotizing and cicatrizing inflammation of all the coats of the ileum which frequently leads to stenosis of the lumen and is often associated with fistula formation and a tumor mass in the right lower quadrant.

PATHOLOGY

The disease apparently in its earlier stages is confined to the mucosa of the small intestine most frequently in the region of the terminal ileum. There are present small oval areas of ulcerations located on the mesenteric border of the small bowel mucosa. The submucosa and to a lesser extent the muscular layers of the bowel show marked inflammatory hyperplastic and exudative changes producing an enormous thickening of the bowel wall to two or three times its size (Figs 1 2 3, and 4). This thickening of the bowel wall encroaches on the lumen of the gut producing varying degrees of stenosis so that the intestine proximal to the involved segment may become greatly dilated. There may be alternating areas of constriction and dilatation (Fig 5).

The mesentery of the affected segment is thickened and fibrotic and contains numerous hyperplastic lymph glands (Fig 6). Later in the disease process the exudate reaction is replaced by a marked fibrosis. There is seen a remarkable extensive fibrosis extending into the mesentery of the involved segment of bowel. A fibrotic stenosis occurs in the bowel itself.

When the terminal ileum is involved the most intense inflammatory reaction is located in the region of the ileocecal valve and the most advanced pathological changes are present in Bauhin's valve which may become converted into a rigid diaphragm with a small opening. This stenotic ileocecal junction (Fig 7), with its adjacent hyperplastic

¹ Read before the Pacific Coast Surgical Association, February 3, 1933.

terminal ileum constitutes the mass which is so frequently found clinically in the examination of the right lower quadrant.

Crohn Ginzburg and Oppenheimer call attention to the marked tendency to slow perforation of the bowel. This perforating process is so chronic that walling off by adhesions to an adjacent viscus or to the omentum and parietal peritoneum is the usual thing. The walled off abscesses resulting from such chronic perforations are often mistaken for appendicular abscesses. Drainage of such an abscess gives rise to a chronic faecal fistula which defies closure because of persistence of the underlying inflammatory disease in the bowel (Case 1).

Microscopically there are no distinctive features, sections show various degrees of acute, subacute, and chronic inflammation. In some cases giant cells are found which are probably the result of a foreign body type of reaction. Otherwise there is no evidence whatsoever to suggest tuberculosis (Figs 2, 3, 4, and 6).

CLINICAL ASPECTS

Clinically Crohn and his associates distinguish four types of this disease: (1) acute—showing signs of intra-abdominal inflammation; (2) symptoms of ulcerative enteritis; (3) stenotic phase with symptoms of chronic obstruction of the small intestine; (4) fistulous stage with persistent and intractable fistulae in right lower quadrant.

Type 1. Signs of acute intra-abdominal inflammation. Before operation these cases are almost impossible to distinguish from acute appendicitis. Colic like pain and tenderness in the right lower quadrant with fever to 101-102 degrees and moderate leucocytosis are present. The onset of symptoms, however appears to be more gradual than in appendicitis. A mass in the right lower quadrant may be present even without abscess formation. At operation there is found a greatly thickened red blotchy terminal ileum with marked edema of the surrounding tissues and slight exudate of the ileal wall. The mesentery is thickened and edematous and contains numerous large glands. Clear fluid is present in the abdomen. An abscess may be encountered

which is seen not to be of appendiceal origin, but because of the contiguous inflammation the appendix may show some involvement of its serosa and the pathologist may report 'subacute appendicitis' on the removed appendix. The appendix however is not related etiologically to this disease. The surgeon is puzzled at the picture he finds and at this time usually considers the diagnosis of ileocecal tuberculosis or lymphosarcoma. The following case history illustrates this stage of the disease.

CASE 1. L. G., white, female, single, aged 19 years. Past history and family history are unimportant. The present illness started about the first of December, 1931 when she began to suffer from vague abdominal symptoms which were characterized by dull epigastric pain with an occasional attack of loose watery stools from three to five a day. These attacks at this time were attributed to intestinal infection. There was no nausea or vomiting. The attacks continued throughout the month of December with remissions of a few days at a time until December 29, 1931 when the patient complained of marked weakness. Dr. Firestone was called in and found the patient had a temperature of 101 degrees. Because of her complaint of pain in the right lower quadrant he diagnosed her condition as acute appendicitis and sent her into Mount Zion Hospital. Physical examination showed a moderately obese young woman who stated that she had lost about 8 pounds during the last month. The examination otherwise was negative except for the abdominal examination.

The abdomen showed moderate distention. On palpation there was a definite rigidity over the right lower rectus muscle with marked point tenderness over McBurney's point. There seemed to be an indefinite mass in the right lower quadrant. Leucocyte count was 12,200 polymorphonuclears, 78 per cent. Temperature was 100 degrees. With these findings a diagnosis of probable appendiceal abscess was made and the patient was taken to surgery.

December 30, 1931, at operation which was performed through a McBurney muscle splitting incision, there was found a considerable amount of free fluid. Exploration of the right lower quadrant of the abdomen showed the presence of a hard mass apparently involving the cecum and terminal ileum. The appendix was located with difficulty and found to be small, atrophic, not particularly inflamed and it was quite apparent that it did not account for the clinical picture and findings. It was removed. Further exploration showed that the terminal ileum was greatly thickened, the serosa reddened and blotchy with a fibrinous exudate covering it. There was general edema of the surrounding tissues and the mesentery of the terminal ileum was edematous, contained numerous hyperplastic lymph glands. The entire mass of terminal ileum, cecum, and



Fig. 1. Case 3. Photomicrograph showing the ulceration of the mucosa and infiltration of the submucosa.



Fig. 2. Case 2. Photomicrograph showing the marked chronic reaction in the submucosa.

ascending colon was fixed and was matted together by fine fibrinous adhesions. During this exploration there was a gush of pus which seemed to come from an abscess located in the wall of the cecum at the junction of the cecum with the ileum. Drains were placed down to this abscess and the abdomen closed. The postoperative diagnoses were (1) tuberculosis of the bowel (2) probable malignancy (3) subacute inflammatory cellulitis of the terminal ileum and cecum of unknown origin.

The pathologist's report on the removed appendix was that of subacute appendicitis, due to the fact that there was an inflammatory reaction in the serosa and muscular layer. The mucosa of the appendix however was quite free of inflammation.

The patient had a stormy postoperative course which was characterized by symptoms of partial bowel obstruction. She became markedly distended and on frequent occasions considerable difficulty

was encountered in relieving this postoperative distention. The drainage from the wound was moderate and the temperature ranged between 100 and 101 degrees for about 10 days after operation. On February 21, 1932 however the clinical picture had improved the wound had completely healed and she was able to leave the hospital. At this time X rays were taken which showed a chronic obstruction of the ileum in the region of the cecum (Fig. 3). The nature of the disease process however was still a mystery, and it was decided to observe the patient further. The details of the follow-up and subsequent course of this patient will be given later in the paper.

Type 2. Symptoms of ulcerative enteritis. There is a history of diarrhea associated with colic like peri-umbilical pain and lower abdominal pain related to defecation there being three to five liquid stools a day which may contain pus mucus, or visible blood. A constant low grade fever is present and with



Fig. 3. Case 2. Photomicrograph showing the inflammatory reaction in the serosa.

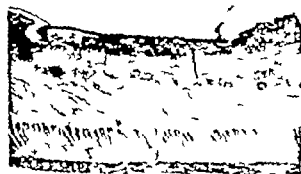


Fig. 4. Case 1. Photomicrograph of the wall of the bowel showing the chronic reaction in the submucosa.



Fig. 3. Case 3. Photograph showing the areas of dilatation and constriction.

the progress of the disease there is marked loss of weight and a pronounced secondary anemia. The course may continue for as long as a year with increasing exhaustion or more frequently the case passes gradually into the stenotic phase of the disease.

CASE 2. E. M., school girl, aged 18 years, single. This patient entered the Children's Hospital under the care of Dr. W. H. Bender. One of us saw her in consultation and later operated upon her. She complained of lower abdominal cramps, nausea and vomiting. Her family history and past history were essentially negative. Patient had always been well without any abdominal symptoms until September 1931 when without any apparent cause she began to notice lower abdominal cramps with four or five loose bowel movements daily. Bowel movements were foul but never bloody. Symptoms continued with varying degrees of severity but the patient was able to continue her school work. She was seen by her family doctor who made a diagnosis of chronic appendicitis. He advised operation which, however, was declined.

In February 1932 as her symptoms were still present she consulted another doctor who subjected her to a complete examination including X-rays and laboratory examinations of stools, etc. and made a diagnosis of colitis. She was treated medically and improved somewhat but after a few months the symptoms became more marked and the patient stated that with her attacks of abdominal cramps she noticed wave like movements over her lower abdomen which was probably due to visible peristalsis. During this period of time she gradually lost weight. Her weight at onset of illness was approximately 130 pounds and on admission to the hospital in August 1932 about 1 year after the onset of her symptoms, she weighed 100 pounds.

Physical examination was essentially negative except for the fact that the patient had lost considerable weight and her temperature was 100.6 degrees. Examination of the abdomen, however, showed a smooth, oblong mass, palpable in the right lower quadrant which was thought to be cecum. There could be seen visible peristalsis during the attack of cramps that the patient complained of. Her hemoglobin was 80 per cent, red blood cells 4,500,000, white blood cells 8,000 with 74 per cent polymorphonuclears. This high count was probably due to dehydration.



Fig. 6. Case 3. Photomicrograph of a lymph node showing endothelial hyperplasia and foreign body giant cell reaction.

Course in hospital. The patient was put on medical regimen. Every type of laboratory investigation was carried out. She continued to lose weight and had persistent abdominal cramps with nausea, vomiting, and diarrhea. Her weight went down to 91 pounds over a period of 17 days that she was under observation in the hospital.

Check up gastro-intestinal series taken on August 25, 1932 with serial films taken 3, 6, 9, 12 and 15 hours after the administration of barium by mouth showed definite small bowel obstruction probably in the terminal ileum (Fig. 9). Operation was advised.

Operation was performed by Dr. Harold Braun on August 27, 1932, following transfusion of 500 cubic centimeters of blood. When the abdomen was opened there was found a hard, annular constriction of the lower ileum about one foot above the ileocecal valve and involving the ileum for about 6 inches (Fig. 10). The corresponding segment of the mesentery was markedly thickened and edematous (Fig. 11). It was superficially inflamed, and there were flecks of fibrin in the peritoneal covering on this part of the bowel. The adjacent mesenteric glands were moderately enlarged. The cecum was found to be essentially normal. A resection of the pathological area of the lower ileum was performed with end-to-end anastomosis. The patient expired on the fourth day after operation. Postmortem examination was refused.

This case illustrates the type that goes on for a period of many months, is treated medically with a diagnosis of some type of enteritis or colitis and ultimately comes to operation because of the development of symptoms of a partial obstruction of the small bowel.

Type 3. Stenotic phase. In Crohn's experience this is the type most commonly found.



Fig. 7 Case 1. Photograph of the gross specimen, showing the dilatation and constriction.

The symptoms are now those of a partial obstruction of the small intestine. Violent cramps with attacks of vomiting and constipation are present. Visible peristalsis and distention are common. A palpable mass is usually present in the right lower quadrant.

The stenotic phase may occasionally occur as the first manifestation of this disease although minor symptoms may have been present for years.

CASE 3. A H. male white 24 years of age married, entered the University of California Hospital December 13, 1932. He complained of cramp-like pain in the upper abdomen. The past history was essentially negative except for the fact that at the age of 11 years he began to have abdominal symptoms of nausea without vomiting, loss of weight and anemia which lasted for 3½ years. At that time he was studied in the Mount Sinai Hospital, New York City and was finally discharged without a diagnosis. After 3½ years, his abdominal symptoms disappeared without having followed any particular regimen and he was in fairly good condition up to the onset of present illness except that he was always rather thin and anemic in appearance. The present illness started in July, 1932, when he noticed transient attacks of abdominal cramps with nausea and vomiting. At the onset of these symptoms in July he was studied at the University of California Hospital and was finally discharged with a diagnosis of pylorospasm; etiology undetermined.

On December 13, 1932, he re-entered the hospital with the same complaint of abdominal cramps, nausea and vomiting but he had in addition lost 20 pounds during the preceding 3 months and his symptoms were now so severe that he was totally incapacitated. The patient, who was a medical student, stated that he had noted recently when attacks of cramps came on that he could see isolated dilated loops of bowel through his abdominal wall.



Fig. 8 Case 1. Roentgenogram showing dilatation of the ileum and a narrow tract extending into the cecum.

Physical examination was negative except for loss of weight and abdominal findings. The abdomen was thin with slight fullness in upper right quadrant. Visible peristalsis could be seen at times. On palpation an indefinite mass just to the right of and just above the umbilicus was felt which could be moved from side to side. No muscle spasm or rigidity was present. Red blood cells 5,350,000; hemoglobin 103 per cent; white blood cells 5,750 with 63 per cent of polymorphonuclears. X-ray examination (Dr. Stone) showed partial obstruction of small bowel at lower jejunum or upper ileum (Figs. 12, 13).

Operation. When the abdomen was opened the jejunum was found markedly dilated and hypertrophied measuring 12 centimeters in circumference from Treitz's ligament distally for a distance of 60 centimeters. At this point there was an annular constriction about 4 centimeters long, then a dilated segment 9 centimeters long, following which there were alternating areas of dilatation and constriction for a distance of 60 centimeters (Fig. 5). The mesentery was greatly thickened due to edema and enlarged lymph glands. There was some free abdominal fluid. There was no evidence of acute inflammatory changes in the bowel wall. Ninety-five centimeters of the diseased bowel was resected and a side-to-side anastomosis performed. Patient did well for about 36 hours and then expired suddenly. No postmortem examination was made. This case is illustrative of the type in which the stenotic phase of the disease is its first manifestation.



Fig. 9. Case 1. Dilatation of the ileum.

Type 4. Fistulous stage. Fistula formation is fairly constant in this disease. More commonly the connection is with the sigmoid; next in frequency the cecum and ascending colon; and even the transverse colon. Practically diagnostic of the disease is a fistula in the abdominal wall persisting and appearing after operation for a supposed acute appendicitis and the removal of an innocent appendix. These fistulae seem to connect with the cecum, but are in reality communications between the necrotic terminal ileum and the anterior abdominal wall. They differ from simple appendiceal fistulae in that they never close spontaneously; resist simple surgical closure by excision and inversion of the stump; and as already stated, connect with the terminal ileum rather than the cecum.

Another peculiar feature of these fistulae is that they may develop months after the original drainage operation for a supposed appendiceal abscess. The original wound meanwhile has completely healed and the first sign of the fistula formation is the appearance of an abscess in the wall which, on being opened, is found to lead to the intestine.

CASE 1 (Part 2) L. G., white, aged 19 years, single. This patient was operated upon on December 30, 1931, for acute appendicitis with the findings as described in the preceding part of this paper under Case 1.

She re-entered the Mount Zion Hospital on June 23, 1932, stating that she had remained quite well following her discharge from the hospital in the early part of February for a period of about 1 month. She then noticed an abscess formation in her wound and consulted Dr. Franklin I. Harris who on opening the abscess discovered that it led to a fistulous tract which appeared to connect with the intestine. This fistulous tract was treated conservatively and at times appeared to close, but when this happened the patient developed symptoms of partial bowel obstruction which were not relieved until the fistulous tract opened up.

General physical examination was essentially negative except for the abdominal examination. Examination of the abdomen showed an irregular McBurney's scar in the right lower abdomen at the distal end of which there was a discharging sinus from which at times gas and liquid feces appeared. There could also be palpated a small indefinite mass in the right lower quadrant. X-ray examination of this patient as previously reported showed a chronic obstruction of the ileum at the region of the cecum. Injection of the fistula with Epidol showed it to lead apparently to the ileocecal region. It could not be definitely demonstrated at this time whether it connected with the terminal ileum or the cecum. It was decided to re-operate upon this patient in order to close the fistula and to explore the cause of the partial bowel obstruction found in the earlier X-ray examination (Fig. 8).

Operation was performed on June 27, 1932, by Dr. Franklin I. Harris. An incision was made encircling the fistulous tract, which was carefully dissected down and found to lead apparently to the junction of the terminal ileum to the cecum. At this time it was thought that it led to the cecum, but we now know that it led to the terminal ileum. For their examination of the ileocecal region showed that the tremendous inflammatory reaction noted in the preceding operation in December had subsided considerably. There was now seen and felt a nodular mass in the ileocecal junction. The terminal ileum was thickened and the transverse colon which was adherent at this point was carefully dissected free and there was found an imperforate fistulous connection between the transverse colon and the terminal ileum and cecum. This opening in the transverse colon was closed and this part of the bowel separated from the ileocecal mass. Because of the findings of definite obstruction in the ileocecal region with fistulous tract leading to it, it was decided to resect the terminal ileum with the cecum and part of the ascending colon. About 4 inches of the terminal ileum was removed with the cecum, the adjacent fistulous tract and part of the ascending colon (Fig. 7). A side-to-side anastomosis was performed between the distal end of the ileum and



Fig. 10. Case 2. Showing the lower end of the ileum. Proximal segment dilated. The narrowing of the lumen and thickness of the wall is very well shown.



Fig. 11. Case 2. Reverse side of Figure 10 showing the thickness of the mesentery which gave the impression of a tumor formation.

the transverse colon. The patient made an uneventful recovery and at the present writing is enjoying excellent health without any abdominal symptoms whatsoever.

This patient illustrates two phases of the disease, her first attack simulating the phase in which the disease is mistaken for acute appendicitis the second stage illustrates the fistula formation so commonly found in this disease process. One incomplete fistula led to the transverse colon the other to the anterior abdominal wall.

DISCUSSION OF NOMENCLATURE

There seems to be little doubt that Crohn, Ginzburg and Oppenheimer have brilliantly isolated from the existing confusion of benign inflammatory intestinal lesions a new disease entity. Clinically the disease occurs mainly in young adults with symptoms resembling those of ulcerative colitis, namely fever, diarrhoea and emaciation. They are often mistakenly operated on for acute appendicitis. The disease process eventually leads to an obstruction of the small intestine with characteristic obstructive symptoms. The outstanding physical findings in this disease are a tumor mass over the site of the lesion and the common formation of fistulae. The etiology is unknown. The microscopic and macroscopic pathology are constant and characteristic. It is a benign disease and according to the investigations of Crohn involves only the terminal ileum.

We question, however, their limitation of this disease process to the terminal ileum. One of our cases and another case we are not reporting in this paper clinically and microscopically showed the characteristic lesions described by Crohn and associates and involved mainly the jejunum. It is our belief that with more universal recognition by surgeons of this disease process other cases will be reported involving the jejunum as well as the terminal ileum. For this reason the name regional ileitis deserves some discussion as to its fitness. It seems to us that until such time as its etiology is determined a more descriptive term is advisable based on the pathological process and should include also the idea that any part of the small intestines may be affected. With this thought we are offering the term 'chronic cicatrizing enteritis'.

RADIOGRAPHY

The disease is commonly overlooked by competent roentgenologists unless the clinician suggests it and demands serial fluoroscopic examinations of the barium meal. Such examinations may show delay in the small bowel early in the disease and later in the stenotic phase definite evidence of obstruction with dilatation of small bowel loops.

When the disease simulates ulcerative colitis a barium enema is usually attempted and as would be expected is reported as negative. Such a negative finding with clinical features suggestive of colitis and enteritis should make



Fig. 12. Case 3. Roentgenogram showing the dilatation of the small bowel (jejunum) extending across the abdomen.



Fig. 13. Case 3. Roentgenogram showing the dilated small bowel and a pocket of barium such as is seen in a diverticulum.

the clinician insistent on a careful serial roentgenological examination with a barium meal.

DIFFERENTIAL DIAGNOSES

The lesion must be differentiated from other well recognized conditions which produce a mass in the right lower quadrant with diarrhea and fever. Under this category are listed non specific ulcerative colitis, ileocecal tuberculosis, mesenteric tuberculosis, Hodgkin's disease, lymphosarcoma, and more rarely actinomycosis.

TREATMENT

Medical treatment is symptomatic and supportive. A complete cure must depend on the surgical resection of the diseased bowel. In cases in which this has been done successfully the patient has been restored to complete health. Such a case may require multiple stage operations. In the light of our experience a preliminary short circuiting

operation such as ileocolostomy with a later resection of the diseased bowel when the patient has been built up would seem to be the better surgical judgment.

Simple ileocolostomy without the removal either at the original operation or later of the diseased obstructed bowel carries with it the added danger of the obstructed bowel becoming dilated and ulcerated. The recent work of Holm has definitely shown both experimentally and clinically that the side tracked bowel in short circuiting operations is a constant menace to the health of the patient. A. A. Berg of New York who has had the greatest experience in the surgical treatment of cases of regional ileitis advocates resection with ileocolostomy as the operation of choice.

SUMMARY

1. Crohn, Oppenheimer and Ginzburg have described a surgical disease which they call regional ileitis. This disease has well

defined clinical and pathological characteristics and its description will be found to cover many of the heretofore unclassified inflammatory tumors and lesions of the small bowel

2 We are reporting 3 cases of the disease, in 1 of which the jejunum was found to be mainly involved

3 The name of 'chronic cicatrizing enteritis' is suggested as a more descriptive and inclusive term for this new surgical entity

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CLINICAL SURGERY

FROM THE DEPARTMENT OF SURGERY WASHINGTON UNIVERSITY

THE CORRECTION OF SCROTAL HYPOSPADIAS AND OF EPISPADIAS

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TO be really useful any plan for the operative correction of either hypospadias or epispadias must fulfill four requirements:

1. It must utilize tissues of approximately the same bulk and elasticity as are the normal structures it restores.

2. The plan of using these must be inclusive,¹ exact and surgically correct.

3. It must relieve the chordee, or the reverse that usually complicates one of these conditions.

4. It must reproduce a functional urethra.

Partly from our own blunders and largely from re-operation in patients who had been previously worked upon, we have formed the opinion that no tissue will make a satisfactory restoration except that which comes from the penis or scrotum. Most others are too bulky and all including free skin grafts, lack elasticity.

In practically all cases having well developed testicles there is originally enough spare scrotal covering to make a generous functional restoration provided it is properly used. Too often the repair is complicated by loss of tissue from previous operative attempts or from incisions made across the direction of the blood supply.

HYPOSPADIAS

At first thought a functional urethra might seem to be the most important objective, but this is not so. In childhood the urethra is of primary interest, but, after man's estate has been attained a restoration that has failed to correct the chordee, which seems to be essential to complete hypospadias, is not apt to be acceptable. Men who have been given functional urethras continue to present themselves for re-operation on this account.

In the following illustrations, which are selected from sketches made at the operating table,

¹Inclusive plan refers to correlation of the separate steps. Inclusive excises conserves tissue and preserves the quality of the result. The plan will be surgically correct when the right tissues are so patterned, placed, and subsequently cared for as to secure circulation, promote union, and give the best possible ultimate function.

and in the legends which accompany them, an attempt is made to illustrate plans of treatment for both hypospadias and epispadias which, for us, have reduced the average number of steps and have eliminated much uncertainty from the immediate and ultimate results.

The one essential difference between these and the plan we hesitated to publish a quarter of a century ago is that now we use a broad, short covering flap in place of the long narrow one with which at that time we sought to avoid the uncertainty essential to the attempt to both line and cover the new urethral section from flaps taken entirely from the penis. An attempt to restore the urethra before the age of 5 years may not be advisable but straightening the ventral concavity can usually be done at the age of a year or two while by choice the whole correction should be completed before puberty.

In a popular system of surgery in the article on hypospadias it states: "In any case the results are obtained with difficulty. In the scrotal varieties surgical treatment can accomplish nothing." At the time this appeared we had successfully treated several cases of the latter type, and, after reading the statement quoted, drawings were made preparatory to publication of the plan. However the loss of the covering flap in a subsequent case demonstrated the need of further study and it was a number of years before we again felt sufficiently sure of the plan to warrant its presentation. Among other experimental plans, in one case, a free transplantation was made of a section from the muscular layer and mucosa of the patient's own appendix, which plan, at the time, was being considerably discussed. The tube remained patent, but we removed it some months later because its length had shrunken badly. It entirely negated its usefulness. The man had previously been given a functional urethra but came to us for relief of the chordee.

The attempt noted was prompted by a report from Dr. Stewart McGuire of a successful homo-appendix transplant in a young boy which, according to the information he subsequently received, had continued to function for the missing section of the urethra.

In laboratory experiments of our own, in the reported experiments of others, or in any actual clinical report of patient the survival of epithelium has not been demonstrated microscopically where a graft of latissimus musculus has been implanted into or under the surface.

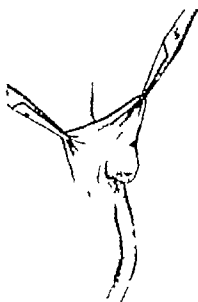


Fig. 1



Fig. 2

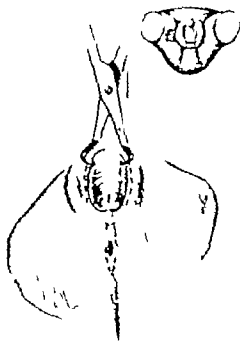


Fig. 3

Fig. 1. Uncomplicated scrotal hypospadias. Drawing made at the age of 10½ years immediately after breaking up the coronal adhesions, showing the more characteristic appearance of a scrotal hypospadias not operated upon. Note the wealth of movable penile skin on the dorsum and sides which is available for the repair flaps. The shaded spot on the scrotum indicates the position of the urethral opening.

Fig. 2. Uncomplicated scrotal hypospadias. Traction on the glans better demonstrates that this redundant skin covering envelops the dorsum and sides of the organ like a loosely draped cloak, with a high roll collar covering the corona, but that along the ventral surface it is closely fixed to an underlying non-elastic band of fibrous tissue that draws the scrotal opening of the urethra forward, and the glans backward. The deep surface of this fibrous band is so closely adherent to the underlying corpora cavernosa that it prevents elongation of this surface of contact. In erection this acts somewhat as a taut bow string, causing the chordee referred to in the text (see also Figs. 1 and 3).

Fig. 3. Uncomplicated scrotal hypospadias—first operative step. This figure and Figure 4 show another instance in a 14 year old child, in whom the general formation of the external genitalia is of a still more primitive type than that illustrated in Figure 1. Besides the scrotal hypospadias, which is a characteristic of the female pattern, the two halves of the scrotum here meet above, envelop the base of the penis, very much as do the labioscrotal folds in the 4 week embryo. (Kehel's reconstruction of human external genitalia of 33 day old embryo¹) See insert on Figure 3. All of the urethra anterior to the scrotum is congenitally absent but in the development the scrotal urethra has been drawn forward and the glans backward until they are separated by the short connecting fibrous band.

Partial Hamman Society

The first objective of an operation that seeks to build up an approximately normal condition should be to liberate the ventral surface of the corpora cavernosa by dissecting off all of this band, and also freeing that part of the urethra which has been displaced forward. This will bare the whole of the under surface of the essential sheath of the cavernosa in its pendulous portion and demonstrate the full extent of the urethral defect. Occasionally a narrow tract will be found in this fibrous tissue that, in direction and location, simulates the missing urethral section. This we remove with the fibrous tissue because an attempt to utilize it would defeat one of the essential objectives of the operation.

This new increase in the distance between the urethral opening and the glans is made permanent by transfer to the ventral surface of sufficient elastic penile covering to permit of full elongation when the cavernosa are engorged. It is from this transferred skin that the lining of the new urethral section will ultimately be made. In a previously unoperated upon case this can be obtained by continuing the coronal incision completely around the dorsum just slightly proximal of the line where the prepuce is attached, making a dorsal slit as shown in Figure 4. These incisions are made to and the undermining is done in the areolar tissue plane that permits the free movement of the skin covering. The double fold of skin forming the prepuce may contain some fibrous bands, the cutting of which may be necessary before it can be entirely flattened out into a flap. If the meatus is to be placed at the frenum, the length of the dorsal incision will be a little more than one-half the diameter but, if the meatus is to be at the tip of the glans, then the length of the dorsal slit must be increased by the length of the glans. It is well to decide upon the location of the meatus after these flaps have been freed and the blood supply has been demonstrated.

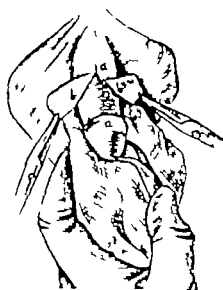


Fig. 4



Fig. 5.

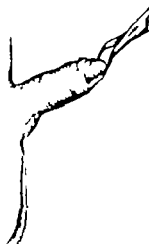


Fig. 6.



Fig. 7

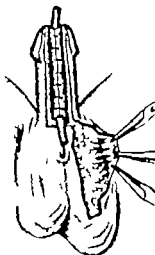


Fig. 8.



Fig. 9



Fig. 10.

Fig. 4. Uncomplicated scrotal hypospadias—first operative step. The condition after removal of fibrous tissue from the ventral surface, completion of the coronal incision and dorsal split, and the flaps freed ready to suture. The first step in suturing is to unite *a* to *a* and the free borders *a-b* and *a-b* along the skin incision surrounding the corona. The distal parts of flaps may have glass part of new urethra.

Fig. 5. Uncomplicated scrotal hypospadias—first operative step completed. Shows the scrotal meatus moved back into its correct location, and the whole of the under surface of the body covered and the cut in the glass lined with skin shifted from the sides and dorsum. If, from lack of available prepuceal skin, naturally or from previous operations, it seems impractical to restore the urethra beyond the frenum, functional result can be obtained by placing the new meatus at this level, and the operation will become quite a bit simpler as will be seen from Figures 13 and 14.

Fig. 6. Uncomplicated scrotal hypospadias. Compare Figures 1 and 2 to see the lengthening of the body, the more backward position of the original meatus and the more normal contour that has resulted from the preceding steps.



Fig. 11



Fig. 12

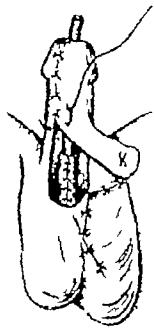


Fig. 13

Fig. 7. Uncomplicated scrotal hypospadias—second operative step. Same case, 10 months later when the second operative step was undertaken to construct the pendulous part of the urethra. The lining of the new urethral section is to be made from the previously transplanted penile skin, the resulting raw areas covered by a wide short scrotal flap. The incisions are shown by the dotted lines. The width of the outlined skin strip *A* equals one and one-half times the circumference of the desired lumen of the tube and its posterior extremity corresponds to the site of the normal bend of the flaccid organ. We have found it a mistake to attempt to reconstruct the urethra farther back at this time. The *K* flap is made amply long and wide to cover the *A* area. The base of this *A* flap is very broad and is toward the blood supply which comes in laterally.

Fig. 8. Uncomplicated scrotal hypospadias—second operative step. The *A* flap has been partially freed along each longitudinal incision but sufficient central attachment is left to insure blood supply. The flap itself is made into a tube by interrupted No. 000 40 day chromic catgut, the free ends of each knot being left to protrude anteriorly alongside of the piece of contained catheter. To simplify the drawing these protruding ends are not shown. The scrotal flap *K* has been raised ready to apply to the raw surface when the body is flexed and rotated to secure contact.

Fig. 9. Uncomplicated scrotal hypospadias—second step continued. The body is bent down and partially rotated to get this contact. Part of one row of interrupted chromic gut sutures is seen protruding along the base, the loops of which engage the right border of the defect, while a second row of sutures, catgut, or horsehair, is uniting the free margin of the scrotal flap to the left border of the defect. Note that this flap is cut quite a bit longer than is apparently needed, and that its distal end is folded so that the new meatus will be bordered by a rolled edge and not a scar line. A few interrupted horsehair or fine chromic gut sutures can be used to bend the center of the flap to the lining (see Figs. 25 and 26, epispadias). One of the very important points here attained is the elimination of superimposed suture lines, which thus gives greater assurance of

primary closure. This feature is incorporated in some of the standard techniques but the method is not utilized in others.

Fig. 10. Uncomplicated scrotal hypospadias—second step continued. Final closure of the wound is accomplished by drawing the cut scrotal edge that corresponds to the free end of the *K* flap up to the right border of the defect on the under surface of the penis, that border which was approximated by mattress sutures to the base of the *A* flap (Fig. 9).

Fig. 11. Uncomplicated scrotal hypospadias—third operative step. The result of the previous step and also the incision for freeing the covering flap from the scrotum. This runs along the base of the *K* flap which has now become united to the under surface of the penis. Above it outlines an area which will be raised with and give additional length to this flap.

Fig. 12. Uncomplicated scrotal hypospadias—third step continued. The *A* flap has been cut free from its original attachment and partly mobilized, the resulting raw surface being shown, and also, by dotted line, the plan of completing the urethral lining. For this step a simple drainage catheter is placed and maintained just within the neck of the bladder.

Fig. 13. Uncomplicated scrotal hypospadias—third step continued. The urethral lining has been completed throughout, the scrotal defect has been closed, and the freed part of the *A* flap is about to cover the urethra. If the *K* flap is not long enough entirely to cover the last section of urethra without ventral traction, it can be supplemented by tissue drawn from the scrotum of the opposite side. Usually the skin which furnishes the urethral lining is smooth but an occasional stray hair may be found, on careful examination. It would seem important that the urethral lining be free of hair but, in operating before puberty they would likely be overlooked. It is well to make a careful search of the field with a magnifying glass and, when hair is found, each hair bulb is made evident by gentle traction on the hair and the bulb excised through a minute incision. For this procedure and for the cutting and raising of the flaps a knife of razor sharpness is necessary.



Fig. 14.



Fig. 15.

EPISPADIAS

The chief characteristics of epispadias are a penis very thick and short with a dorsal cleft between the corpora cavernosa that extends into the urethra almost throughout the entire length of the organ. There is little prepuce dorsally but this deficiency is compensated for by a redundancy of loose covering on the ventral surface. The condition is frequently complicated by some lack of vesicle control which in the cases we have treated was apparently due to traction on the very short urethra at least control was made much more certain after this traction was released. (When there is an associated ectrophy of the bladder control is of course impossible.)

The objectives of the operation are (1) To release the tension resulting from the short urethra, the pull of which seems to lessen the effectiveness of a sphincter that is most likely somewhat lacking in strength and also draws the glans against the pubis, (2) to effect closure of the dorsal cleft.

The first objective is accomplished by dissecting the open urethra free from its attachment as far back as the abdominal wall, and then, while the glans is drawn firmly forward and the urethra remains perfectly relaxed, the latter is sutured to the bed as it lies. The plans for obtaining material for piecing out the missing distal part of the urethra and for closing the cleft closely follow those used for hypospadias.

The original appearance the plan of correction and the result in a typical case are detailed in the

following series, which depict the various operative steps in a child of 13 years. In this condition the attempt to make both the lining and covering of the urethra entirely from the bordering penile skin has, in our hands, proved even less certain of result than for hypospadias.

The postoperative dressings and treatment of these are a modification of that described under hypospadias.

In the foregoing we have attempted to illustrate the handling of typical cases of complete scrotal hypospadias or of epispadias in which the patients had not previously been operated upon. Cases of less involvement are treated accordingly. There are possibilities of much grief and disappointment in this work. Operative results may be unsatisfactory either from fault in plan, execution, or healing. In attempting to correct our own and others' mishaps we have had to resort to elaborations or variations of the above plans, but, on the average, satisfaction followed only when they were in harmony with the cardinal principles given at the beginning of this paper. Our observations have forced us to the conclusion that some advocated plans are too uncertain of result, and that others will bring disappointment no matter how good the execution or the healing.

DRESSINGS FOR HYPOSPADIAS CASES

The dressing for the first stage operation is done with the penis brought up midline against the abdomen, a gauze flat interposed. This is



Fig. 16.

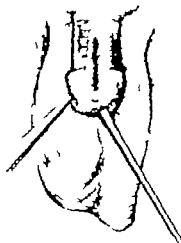


Fig. 17



Fig. 18.



Fig. 19.



Fig. 20.



Fig. 21

Fig. 16. The natural appearance of an uncomplicated epispadias with the prepuce excess of skin draped from the under-surface. Slight rotation of the glans is caused by the traction of the short urethra.

Fig. 17. Uncomplicated epispadias—first operative step. The penis has been drawn out to the fullest extent permitted by the short urethra. The cleft is shown and also the incision for freeing the open part of the urethra from its anterior and lateral attachments.

Fig. 18. Uncomplicated epispadias—first operative step. The beginning of the dissection which mobilizes the urethra. The detached anterior part of the open urethra is being drawn backward by the forceps.

Fig. 19. Uncomplicated epispadias—first operative step. The transplanted urethra is shown sutured into its permanent position leaving the resulting raw surface of the corpora cavernosa and glans exposed. A cut that has been

made deep into the glans for embedding the new section of urethra is also shown.

Fig. 20. Uncomplicated epispadias—first operative step. The spreading part of the two halves of the dorsal portion is shown and the tip of the glans as a result of the median cut mentioned under Figure 19. The coronal and a ventral vertical incision for switching prepuceal skin to form the lining of the new urethra are also shown.

Fig. 21. Uncomplicated epispadias—first operative step. The lining of the new section of urethra which is still opened dorsally, has been formed from skin switched from the sides and under surface of the body. Comparing the positions of A and C as shown in Figures 20 and 21 will give a general idea of just how the new section of urethra was obtained. This completes the first step of the operation. In this condition the new meatus should be placed at the tip of the glans and not at the corona.

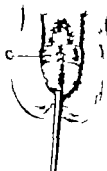


Fig. 22



Fig. 23



Fig. 24

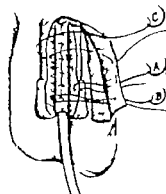


Fig. 25



Fig. 26



Fig. 27

Fig. 22. Uncomplicated epispadias—first operative step. This is from a different case in which the dorsal groove extended to the normal position of the meatus at the tip of the glans and was lined throughout with apparently normal urethral mucosa. In this case the urethra was liberated by transverse incision at the corona. The proximal portion of the urethra was undermined and the prepuce flaps were switched into the resulting defect (see Fig. 20).

Fig. 23. Uncomplicated epispadias—second operative step. The dotted line here indicates the incision which mobilized the borders of the cleft as the first step in closing the urethra.

Fig. 24. Uncomplicated epispadias—second operative step. The lining of the urethra has been sutured over a catheter which rests just within the bladder. The outline of a scrotal covering flap is also shown.

Fig. 25. Uncomplicated epispadias—second operative step. The scrotal covering flap has been dissected free with one suture in each of three rows which will be used to fix it in its new position. *A* is one of a line of interrupted mattress sutures that pierce the base of the flap and will here

engage the left border of the defect. *B* represents one of a series that pierce along the central line of the flap and bind it to the suture line of the new urethral lining, while *C* engages the free border of the flap and attaches it to the right border of the defect. The lower free border of the covering flap was turned under to form the dorsal border of the new meatus in such a way that the scar will not be just at the entrance (see Fig. 9).

Fig. 26. Uncomplicated epispadias—second operative step. The flap is shown sutured in place with the positions of the *A-B-C* sutures indicated. Naturally these must be sufficiently lax and sufficiently far apart to permit of free circulation within the flap. Any cutting in of a suture in the center row might cause a permanent leak, which would require further correction by an extra operative step. This completes the second step of the operation, but on this is indicated the position of the incision which freed this flap from the scrotum in the final step.

Fig. 27. Uncomplicated epispadias—third operative step. The operation completed. The base of the scrotal covering flap has been cut and the raw edges sutured back on the body and on the scrotum.

covered with more saline gauze flats, over which is placed a large soft, damp marine sponge covered by a pad, the whole being fixed in place by a double spica. The sponge should be at least 6 or 10 inches across 2 to 3 inches thick and softly resilient so as to transmit the bandage pressure to the sides as well as to the ventral surface of the penis. As the sponge dries it hardens and if carefully applied without too much underlying gauze it will prevent displacement and limit priapism. This bandage should exert just sufficient even pressure to hold the tissues in firm apposition, and to prevent accumulation of blood or secretions under the flaps. The retention catheter that has already been placed just within the bladder may be brought out above or through the bandage and the scrotum may be lightly supported with a pad included in the folds of the dressing. The retention catheter is given ordinary routine care and usually removed on the fourth day when the dressing is first changed, or before that if it becomes irritating.

An attempt is made to maintain this elevated position until complete healing has occurred possibly longer.

In the second stage operation in which the urethra is completed throughout the pendulous portion the body is bent downward fixed to the scrotum. This changed position is maintained by practically the same type of dressing described but which is now applied to the dorsal surface and must also support the scrotum. The new portion of urethra is constructed over a section of a fairly large catheter which may extend on into the bladder or drainage may be maintained through a separate catheter introduced through the scrotal opening. It is highly important that

the tube within the newly constructed section be retained at least 10 days.

At the third stage operation in which the body is freed from the scrotal flap and the urethra is completed, the penis is dressed against the abdomen as it was at the first operation. The catheter at this time of necessity traverses the whole urethra and is usually retained only a few days.

For one or a few days after each operative step the catheter may be connected with a bedside bottle but it is usually practical simply to close off the catheter and empty the bladder at intervals.

In adolescent and adult patients particularly the possibility of priapism must be forestalled. This might be disastrous especially after the second operative step. For this purpose drugs are unreliable but so far we have found the proper application of the pressure dressing described to be quite adequate. This pressure is usually maintained for a week or 10 days but after firm healing has occurred most patients are permitted to substitute a regular athletic supporter not the simple suspensory as a more comfortable method of fixation which the patient can remove for urination and for sitz baths.

The same general ideas are carried out in dressing the cases of epispadias except that the position of the catheter and of the penis itself have to be maintained differently.

The after treatment of a successfully operated upon case is simply that sounds or catheters be passed regularly as a rule starting after the first month, every 2 or 4 weeks for 1 year but many patients do not go through with this plan and have no evidence of stricture.

The complication of epididymitis may occur in patients who have had old infections, but in ours such has not proved serious.

TRANSURETHRAL RESECTION OF OBSTRUCTIONS AT THE VESICAL ORIFICE¹

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DURING the past 18 months a great deal of interest has been manifested in the non-surgical treatment of prostatic obstruction by means of the transurethral electric resection. Many advantages are claimed for this form of treatment, and certain objections have been advanced against it. With this, as with many other new forms of treatment, its adherents are enthusiastic, often to a degree beyond the limits of normal enthusiasm, and great, almost unbelievable, claims are made. The opponents set up objections that may have certain foundations in fact. It would seem, therefore, that the advantages and limitations of this form of treatment can be and will be determined only with the passing of time, during which many groups of cases will be reported and carefully analyzed and comparisons made with similar groups of cases that were treated by operation.

Let us discuss this new form of therapy under two headings: (a) its advantages over surgery and (b) its limitations, if any to effect a cure.

(a) The advantages over surgery are manifold. They may be briefly mentioned as follows:

1. The period of incapacity after operation is brief; hence the stay in the hospital is short.

2. The method can be applied to a group of patients who heretofore were classified as inoperable and hence were denied relief from prostatic suffering.

3. Patients will seek relief at a much earlier period.

4. Shock is eliminated.

5. It is of value in the treatment of carcinoma of the prostate.

6. It is of value in treating certain complications following surgical removal of the prostate.

1. *A shorter period of hospitalization.* It is generally recognized that the period of hospitalization in the average case of prostatectomy is a long one. It is possible, in certain well selected cases, to reduce this period, but short stays in the hospital are not the rule. The relatively long period of hospitalization is often due to the fact that patients enter the hospital late in the course of the disease; they have dreaded surgery and therefore postpone the day of operation so long that severe infection takes place and there is frequently damage to the upper tract, the result

of back pressure, as well as impaired cardiac function. In short this group comprises what has been called bad surgical risks. In this field, as in any other field of major surgery the poor risk patient always requires a longer period of preparation and complications more frequently follow operation and they are more numerous.

On the other hand, when the electric resectoscope is used the period of hospitalization is shorter and complications following treatment are reduced to a minimum. I do not believe that we have been in any particular hurry to discharge our patients from the hospital; no attempt has been made to hurry them, yet it is evident that they have remained less time in the hospital. This is of great advantage to the patient in these times of economic distress.

A review of this series of 162 resections performed on 148 patients shows that the average stay in the hospital was 9 days and in some cases the patient was hospitalized only 2 days.

2. *Application of this form of treatment to a group that heretofore was classified as inoperable and hence was denied relief from prostatic obstruction.* Because of its simplicity and relative freedom of complications this new procedure will be the means of obtaining relief from prostatic obstruction in a certain group of patients who could not be subjected to operative procedures. Patients with severe angina pectoris, for example, who could not be subjected even to a two stage prostatectomy may now with safety be subjected to a transurethral resection. In this series we have had 7 cases of severe angina—patients who it was felt by the cardiologist could never have been able to stand a major surgical operation. And the same may be said for patients with broken compensation due to cardiac failure. Just as the two-stage operation has made relief available to an ever-increasing number of prostatitis, so this new form of treatment will extend its field of application, and many patients, who are denied surgery will be relieved of the obstruction.

3. *Patients will seek relief at a much earlier period.* Many men approaching the prostatic age come to the physician seeking information as to what they or their physician can do to prevent the development of impending prostatic trouble and its train of symptoms. If such patients can

be assured that the prospects are good that a major surgical operation will be relatively free from danger and complications and that the stay in the hospital following such operation will not be long much will have been accomplished in getting this group of sufferers to seek relief during the early stages of prostatism, and, if treated early, the distressing late symptoms can be completely avoided.

4. *The elimination of shock* The advantage of the absence of shock in elderly men particularly those who have severe cardiac disease and disturbances of blood pressure, either hypotension or hypertension or who suffer from cardiac decompensation, is an exceedingly obvious one. When this procedure is carried out rapidly and when particular attention is paid to the control of hemorrhage at the time of resection, the element of shock is practically eliminated.

5. *Its advantages in the treatment of carcinoma of the prostate* The resectoscope has been found of great value in my hands in treating carcinoma of the prostate. It is a well recognized fact that prostatectomy in this type of case is sooner or later followed by a recurrence. As a matter of fact, the large percentage of recurrences has led practically to the complete abandonment of prostatectomy in cases of carcinoma.

Patients with carcinoma to be treated with the resectoscope may be divided into three groups:

a. *Cases of recurrence* Those who have had a prostatectomy before coming under observation and who are again having symptoms that demand relief such as frequency, pain, hematuria or retention requiring the use of a catheter. In this group of cases the resectoscope has been of great value. It is possible to remove the obstructing carcinoma so that complete urinary function is re-established. Should the carcinoma recur in several years it is a simple procedure to do a transurethral electroresection again.

b. *Cases with suprapubic drainage* In many cases of carcinoma, especially in those seen late or relatively late in the course of the disease, a suprapubic cystostomy is done and the patient is doomed to wear his catheter until the end of his life. In just this particular type of case we have had the most gratifying results with the resectoscope, in that it has been possible to remove the obstructing carcinoma completely with the result that the suprapubic fistula heals, thereby adding greatly to the patient's comfort.

c. *Cases of carcinoma not operated upon previously* Whether one favors the use of radium or deep roentgen therapy for carcinoma makes little difference since the form of treatment

desired by the physician can be used after the carcinomatous obstruction has been relieved by means of the resectoscope.

6. *Its value in treating certain complications following surgical removal of the prostate* The persistence of overlooked tags, small adenomatous nodules, and overlooked median bars or middle lobes may be corrected with the resectoscope in a simple and easy manner. The same may be said for the treatment of the strictures at the internal urethral orifice following prostatectomy, although it must be admitted that stricture is very uncommon.

Objections to this form of treatment One of the common objections is that this form of treatment will be followed by stricture with a return of the symptoms. This must await the passing of time to determine its validity.

The second and most frequent objection is based on the fact that the entire gland is not removed, hence recurrence may take place. Recurrences it may be stressed also occur following prostatectomy. However should recurrences follow this new procedure it will be a relatively simple procedure to use the resectoscope again.

SELECTION OF CASES

Every patient with prostatic obstruction should be subjected to a complete physical examination even before instrumental examination is done. Lesions of the cardiovascular system occur in a large number of these patients. In a previous study it was shown that cardiac disease was present in 35.8 per cent in a series of 321 cases.¹ Many cardiac patients when first seen appear to be poor risks for operation. But after careful preparation the majority can be operated upon safely. Some cardiac patients can never be improved so that they can withstand surgery. It is in just this group of cases that transurethral prostatectomy can be carried out with a greater measure of safety than in major surgery. Patients who on account of bad hearts have had a permanent suprapubic catheter in lieu of prostatectomy have had a transurethral resection and the fistulae have healed.

Many of this group also suffer from hypertension. The bad effect that infection, pain, and fatigue has on hypertension is well known. Hypertension is often greatly improved by the indwelling catheter, fluids, urinary antiseptics and rest in bed. Further diminution was noted after the resections, in some instances rather striking as shown by the following table.

| Before | After |
|---------|--------|
| 260/112 | 158/90 |
| 190/104 | 150/84 |
| 196/110 | 116/76 |
| 188/120 | 150/90 |

Since this procedure is carried out under sacral anesthesia allowing change of position frequently and since the patient can be allowed to leave his bed the next day this procedure is particularly desirable in cases of asthma, chronic bronchitis and emphysema, its advantages being obvious.

CONTROL OF INFECTION

A large number of these patients when admitted to the hospital suffer from infection in the urinary tract, therefore efforts should be made to control the infection. In this series of 148 cases infection occurred in 89 cases. Cultures of the urine showed the following types of organisms.

BACTERIOLOGY

| | Cases |
|----------------------------|-------|
| Bacillus coli | 36 |
| Staphylococcus albus | 35 |
| Streptococcus hemolyticus | 7 |
| Staphylococcus hemolyticus | 4 |
| Bacillus coli hemolyticus | 2 |
| Eberthella | 1 |
| Bacillus proteus | 1 |
| Total | 89 |

In the pre-resection treatment of infection the following procedures were employed (1) intermittent catheterization and injection (2) indwelling urethral catheter (3) suprapubic cystostomy

1 *Intermittent catheterization and injection* This procedure was reserved for a small group of cases. It should be borne in mind that even when the greatest care is exercised this method is open to the criticism of added infection.

2 *Indwelling urethral catheter* This was the method of preparation in the largest number of cases showing infection. For preliminary drainage a small catheter is given preference and care to avoid trauma should be exercised when it is passed. Daily bladder lavage with potassium permanganate was used. The catheter should be changed frequently.

3 *Suprapubic cystostomy* In the present status of this subject, a group of cases will be seen that for one reason or another will need a suprapubic cystostomy. These are generally the patients who should undergo prolonged drainage but who cannot be treated by means of the indwelling catheter. In some patients the indwelling catheter is responsible for severe pain in the urethra, and also for a profuse urethral dis-

charge with its inherent dangers of a periurethral abscess. In other patients it causes severe bleeding which frequently plugs the catheter and necessarily interferes with drainage sometimes the bladder becomes filled with blood clots. And finally in a certain number, the indwelling catheter provokes in a short time severe chills, fever, and sweats.

It is my opinion that because of this sequence of events, the best course to pursue is to perform a rapid cystostomy under local anesthesia.

Objections have been advanced against a suprapubic cystostomy when a transurethral resection is contemplated. Transurethral resection can be done just as well when the bladder is open as when it is not open, and in cases in which I was convinced that a suprapubic cystostomy was indicated I have carried it out without hesitation.

The following table shows the methods employed in the preparation of this group of patients.

| | Cases |
|--------------------------------|-------|
| Indwelling urethral catheter | 58 |
| Suprapubic cystostomy | 23 |
| Massage and bladder irrigation | 21 |
| No preparation | 47 |
| Total | 149 |

POSTOPERATIVE COURSE

Bleeding. Immediate postoperative bleeding is generally of minor importance, the amount being dependent on the care that was exercised in the control of bleeding at the time of the resection. It is my opinion that the time and place to control the bleeding is in the operating room while the resection is being done. We try to send the patient back to the ward or room with little or no bleeding and this is easy of accomplishment, experience and patience being essential.

Late hemorrhage. It is but reasonable to expect late secondary bleeding in this form of surgery just as we meet this condition either in suprapubic or perineal prostatectomy. We have had only 7 occurrences, neither of which was alarming. The patients were readmitted to the hospital with suprapubic tumors, that is, their bladders were filled with urine and clots. Evacuation was done by means of a Bigelow pump and then irrigation with warm potassium permanganate sufficient to control the oozing was instituted.

Temperatures. In going over our records we have been greatly impressed by the fact that the febrile reactions are less in number, the temperature range not so high, and the duration of the fever of a much shorter time than is the case when major surgery is resorted to.

The following table shows the postoperative temperatures in this group

Average length of time
Temperature 1-2 days only 83 cases

| Degrees | Cases |
|------------------|-------|
| 98.6 to 99 | 15 |
| 99 to 100 | 43 |
| 100 to 101 | 53 |
| 101 to 102 | 20 |
| 102 to 103 | 17 |
| 103 to 104 | 8 |
| Total resections | 162 |

3-2 days

that many patients are operated upon by this method who have been denied surgery because they have been classified as inoperable. My records show that the mortality following 162 transurethral resections was 3.08 per cent.

CONCLUSIONS

I cannot emphasize sufficiently the definite advantages that this new method has over major surgery in treating vesical neck obstructions, hence it seems to me right and proper to reiterate them

1 The period of illness is much shorter as is the stay in the hospital.

2 Shock is eliminated.

3 Patients will seek relief at a much earlier period than they do at present.

4 A certain number of patients suffering from prostatic obstruction will no longer be denied the possibility of obtaining relief.

5 The new method obviates permanent suprapubic drainage in cases of carcinoma of the prostate.

6 Strictures, contractures, and overlooked bars following prostatectomy may be treated

Epididymitis Epididymitis is a very troublesome complication and as a sequence of surgical removal occurs in about 25 per cent of the cases. Our present series shows 12 per cent. In the majority of cases epididymitis develops after the patients leave the hospital. But, it may be stated as a fact that this annoying complication can be absolutely prevented by a resection of a piece of the vas deferens as a rule I resect about 1 inch

MORTALITY

The results obtained seem to justify the statements that have been repeatedly made that this new form of treatment carries with it a much lower mortality rate and thus in spite of the fact

NON-OPERATIVE TREATMENT OF FRACTURES OF THE TIBIA AND FEMUR INVOLVING THE KNEE JOINT¹

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AND

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THE interest manifest in those fractures which occur in the immediate vicinity of the knee joint, depends not so much upon their frequency or degree of bone alteration as on the threat imposed upon the integrity of that joint. When the fracture lines extend on to the joint surface, either from the femoral or tibial side it has long been assumed that the knee joint function may be seriously if not permanently, impaired. Whether the sequelae of these injuries depend upon the distortion of the articular and weight bearing planes, or ligamentous and cartilaginous tear remains to be shown.

In order that the relationship of these fractures of the femoral condyles and tibial head to ultimate joint function might be more clearly understood, this review of those fractures cared for on Surgical Division "C" and in the Surgical Out Patient Department at the Hospital of the University of Pennsylvania, during the past 10 years, was undertaken.

Anatomical considerations The knee joint, so situated between the longest bones in the skeleton, is subject to frequent and unusual strain. Collins believes the knee joint to be one of the weakest joints. If such were the case, dislocation would occur with greater frequency. A modification of his statement might be blended to read "despite the fact that the knee joint is the largest joint in the body its strength in large part depends upon the multiplicity of muscles, tendons, and ligaments entering into its structural support." The most important of these ligaments arise from the bones intimately to and immediately supporting the weight bearing articular surfaces. Stability in part depends upon the maintenance of the weight bearing planes (condyles and tibial plateau) in their true relationship.

Frequency In a review of 10,399 fractures, Nelson's *Surgery* places the incidence of fractures of the femur at 743 or 7.14 per cent. Of these 82 were of the lower end of the femur 55 per cent of which involved the condyles. The ratio between the internal, external, and both condyles was given as 5:3:4. Of 549 fractures of the tibia, 104, or 19 per cent, were of the upper end, 83 per cent of which involved the head.

In over 13,000 fractures now on record in the files of the Department of Roentgenology at the Hospital of the University of Pennsylvania, from which files the above data were collected, there were 186 fractures involving the knee joint, or about 1.4 per cent. Of this group 52 or 28 per cent, involved the condyles of the femur. One hundred and thirty four affected the head of the tibia, either through the tuberosities or spine. For comparison these fractures have been collected in Table I.

Of the femoral condyles, the external condyle was involved in over half the cases. Of those fractures through the tibial head, the external tuberosity was fractured more frequently. This fact would tend to support direct trauma as being responsible for the major portion of knee joint fractures, since it is the outer and exposed side of either bone that is most frequently injured.

The fractures collected in Table II represent those cases cared for by Surgical Division C and the Surgical Out Patient Department for the past 10 years.

Ollershaw stated that fracture of the articular surfaces of the knee joint comprised about 2 per cent of all fractures. Barbellion in a review of 315 fractures of the leg, placed the incidence of tibial plateau fractures at 3.8 per cent. Steyer in 1300 fractures, found tibial involvement in 5 per cent. Of the 66 fractures of the tibia, 16 or 24 per cent involved the articular surfaces of the knee joint.

Cutler in a recent report, observed 7 fractures occurring between the condyles of the femur 3 of the external condyle, and 3 of the internal condyle. The relative frequency of fractures involving both condyles is greater than that observed in Table I.

The male, for obvious reasons suffered by far more fractures than the female. The greatest proportion of these fractures occurred in the adult and active period of life. But few were observed before 20 years, and fewer still after 60 (Table III, A and B).

Etiology A "bumper fracture" as the name implies, is the result of a direct blow at the knee by an automobile bumper. Cary admits of a complex fracture involving the external tuber-

¹From Surgical Division, C—Dr. E. L. Eliason—Hospital of the University of Pennsylvania. Read at the Philadelphia meeting of the Committee on the Treatment of Fractures of The American College of Surgeons, Philadelphia, January 14, 1931.

TABLE I.—FRACTURES ABOUT THE KNEE JOINT

| Site | Relative Incidence ¹ | |
|------------------|---------------------------------|----------|
| | Cases | Per cent |
| Femoral condyles | 29 | 98 |
| Both | 11 | 1 |
| Internal | 18 | 59 |
| External | 11 | 37 |
| Tibial head | 124 | 79 |
| Spine | 21 | 3.6 |
| Tuberosities | 117 | 87.4 |
| Both | 5 | 4.3 |
| Internal | 78 | 70 |
| External | 22 | 19.3 |
| Anterior part | 4 | 3 |
| Posterior part | 4 | 3 |

¹The above data are collected from the files of the Department of Roentgenology at the Hospital of the University of Pennsylvania.

TABLE II.—FRACTURES ABOUT THE KNEE JOINT

| Site | Relative Incidence ¹ | |
|------------------|---------------------------------|----------|
| | Cases | Per cent |
| Femoral condyles | 6 | 13 |
| Both | 0 | 0 |
| Internal | 3 | 50 |
| External | 3 | 50 |
| Tibial head | 14 | 7 |
| Spine | 30 | 64 |
| Tuberosities | 4 | 13 |
| Both | 9 | 30 |
| Internal | 15 | 50 |
| External | 5 | 17 |
| Anterior part | 1 | 3.3 |
| Posterior part | 1 | 3.3 |

¹The above data represent the relative distribution of the fractures about the knee joint, of those cases on which this study was based.

osity of the head of the tibia with an avulsion of the tibiofemoral joint and rupture of the external lateral ligament of the knee joint. He added as associated injuries, fractures of both tuberosities of the tibia, fractures of the condyles of the femur and fractures of the tibial spine.

Rupture of the crucial ligaments and injury to the semilunar cartilages were included. He was, however, unable to find injury to either in early cases operated upon. In later cases where preter natural anteroposterior movement was used as a criterion for a diagnosis of crucial ligament rupture none were observed. It would appear that one could not be assured of crucial ligament rupture or tear of the external lateral ligament without open operation.

The automobile bumper was responsible for 13 of the 40 fractures collected under Table II. The external tuberosity of the tibia was involved in 6, the internal tuberosity in 4, and both tuberosities in 2 cases. The internal condyle of the femur was fractured in 1 case. If the patients fell down stairs, usually doubling the extremity under the body the external tuberosity was fractured four times. Football tackles were responsible for 2 fractures. Cow injuries the result of head-on

auto collisions, were responsible for 2 fractures. In 14 cases falls were recorded, and in 5 the nature of the injury was not mentioned.

Collins found the automobile bumper responsible for 36 per cent of those fractures of the tibial head.

The mechanics of these fractures is not without interest. Barbiarian, quoted by Collins, was unable to produce fractures of the tibial head by mere internal or external torsion. When to torsion there was added a direct blow the fracture resulted.

Cary believed that the degree of violence was commonly insufficient in itself to produce the extensive injury one often sees. He added that muscular action played an important part, though the trauma was the primary cause.

In extension the knee joint is unusually powerful, while in flexion most unstable. When the fracture force is so directed against the external aspect of the knee as to produce a genu valgum the tibial head, particularly the external tuberosity with the fibula or the external condyle of the femur may be fractured. When the force is so directed against the internal aspect of the knee, as to produce a genu varum, the internal tuber-

TABLE III.—FRACTURES ABOUT THE KNEE JOINT AGE—INCIDENCE

A¹

| Site | Under 40 yrs. | | 1 to 40 yrs. | | 41 to 60 yrs. | | Over 60 yrs. | |
|--------------------------------|---------------|----------|--------------|----------|---------------|----------|--------------|----------|
| | Cases | Per cent | Cases | Per cent | Cases | Per cent | Cases | Per cent |
| Femoral condyles (31 cases) | 13 | 42 | 15 | 49 | 5 | 40 | 3 | 6 |
| Tibial head Spine (7 cases) | 1 | 6 | 2 | 47 | 2 | 47 | | |
| Tuberosities (117 cases) | 11 | 11 | 30 | 43 | 44 | 47 | 11 | 0 |

¹The above data were collected from the files of the Department of Roentgenology at the Hospital of the University of Pennsylvania.

B¹

| | | | | | | | | |
|--------------------------------|---|----|----|----|----|----|--|--|
| Femoral condyles (6 cases) | 3 | 50 | | | 3 | 50 | | |
| Tibial head Spine (4 cases) | 1 | 25 | 2 | 50 | 1 | 25 | | |
| Tuberosities (30 cases) | 8 | 27 | 12 | 40 | 10 | 33 | | |

¹This latter group represents the age distribution of those cases on which this study is based.

TABLE IV—FRACTURES OF THE EXTERNAL TUBEROSITY OF THE TIBIA

| Case | Extent of bone injury | Last follow-up report | Class |
|------|--|---|-------|
| | Comminuted, crushed fracture with widening of the joint surface, plus fracture of the head of the fibula | 8 1/2 years after injury. Walks without limp. No pain. Full extension or flexion. No preternatural mobility. Favors knee when walking up stairs | 2-4+ |
| | Comminuted, crushed fracture, with widening of the joint surface | N follow-up | |
| 3 | Comminuted, crushed fracture, involving the articular surface as far as the spine. Plus comminuted fracture of the head of the fibula | Four years after injury. N pain, weakness or deformity. Not afraid to bear full weight. After long walk through woods or over hills, knee will feel lacy and tired. Recovers in an hour | 2-4+ |
| 4 | Comminuted, crushed fracture, of outer and posterior aspect, with widening of joint surface, irregularity in contour. Fracture of head of fibula | 7 1/2 months after injury. No weakness. No complaints. Complete return of function | 4-4+ |
| 5 | Comminuted fracture, longitudinal into the joint at spine, with irregularity of articular surface at the spine | 3 months after injury. Reported perfect result | 2-4+ |
| 6 | Comminuted, crushed fracture with considerable irregularity at the articular surface, with widening of the plateau | 17 months after injury. Not the slightest complaint. Pays 18 to 25 holes of golf 5 days in succession. Would not know knee had been injured | 2-4+ |
| 7 | Crushed fracture of outer one-third, with upward displacement, and posterior displacement. Comminuted fracture of the head of the fibula | 7 years after injury. No deformity. No pain or disability. No limitation of motion. No weakness. Does not favor knee | 2-4+ |
| 8 | Crushed fracture of the outer one-third, with downward and posterior displacement of fragment | No follow-up. Neighbor said she had no symptoms | |
| 9 | Comminuted, crushed fracture with widening of the plateau. Probable spiral fracture of the femur above | 3 years after injury. No pain, weakness or deformity. Says knee is better than other in which she has rheumatism. Would not know knee had been injured | 2-4+ |
| 10 | Comminuted, crushed fracture with widening of the plateau. Possible fracture of spine | 3 years after injury. No pain, weakness or deformity. Has frequently run for trolley without discomfort. Knee is as good as other | 2-4+ |
| 11 | Fracture line extends through the articular surface at its middle, down and obliquely to the external part of the shaft. Good position | year and 6 months after injury. No pain, weakness or limitation of motion. A tight joint. As good as other knee. Plays golf on holes of golf without discomfort | 2-4+ |
| | Fracture line starts at space of tibia and extends downward for distance of about three inches. Good position | 3 months after injury. Not as strong as other knee. Pains in damp weather. Wishes his tendency to favor that knee | 2-4+ |
| 13 | Fracture produces considerable cleft at outer portion of articular surface | 6 months after injury. No weakness, or deformity. Wishes perfectly. Slight discomfort in wet weather | 4-4+ |
| 14 | Fracture of the external tuberosity with fragments in good position. External condyle of femur split off | No follow-up. His physician thinks he had a perfect result, but is not sure | |
| 15 | Fracture involves the outer portion, possibly in the nature of a spiral fracture | 3 years after injury. Knee is as strong as its fellow. No pain or deformity. No tendency to favor when walking | 2-4+ |

FRACTURES OF THE INTERNAL TUBEROSITY OF THE TIBIA

| | | | |
|----|--|---|------|
| 6 | Comminuted fracture of the plateau. Fragments in good position | 3 years after injury. No discomfort, interference with function, or limp. N deformity | 2-4+ |
| 17 | Oblique fracture line up through the shaft, entering the joint surface. Fragments in good position. Plus upper third of fibula | 10 months after injury. No deformity, weakness. Good joint function. Occasional pain on walking. Tenderness over internal tuberosity | 2-4+ |
| 8 | Comminuted fracture, with crush and widening of the plateau, showing downward and posterior displacement | No follow-up | |
| 19 | Comminuted, crushed fracture, with downward and posterior displacement of entire tuberosity, fracture line involves the spine. Plus fracture of the head of the fibula | 4 years after injury. There is pain, weakness and swelling. Afraid to bear full weight on leg. Limp and drag foot. Shortening | 3-4+ |
| 20 | Oblique fracture line, extending from shaft below the tuberosity, to come out on the joint surface of the external tuberosity. Good position | 5 years after injury. No pain, weakness or deformity. Does not favor knee when walking. Not afraid to bear full weight. Knee as strong as fellow | 2-4+ |
| 21 | Crush fracture of the peripheral one-fourth of articular surface | One year after injury. Pain and tenderness over joint tuberosity. Good function. No limitation of motion. Night bearing without symptoms | 2-4+ |
| 22 | Comminuted fracture of the neck of the tibia, with the fracture line extending between the tuberosity of the spine. Downward displacement of the lower tuberosity. Articulating surface in good position | year and 6 months after injury. Knee is as good as its fellow. No pain, weakness or limitation of motion. No preternatural mobility. Does not favor knee when walking | 2-4+ |
| 23 | Fracture through the peripheral one-fourth of the tuberosity. Fragment in good position | 1 1/2 years after injury. No pain or deformity. No weakness. Perfect function, except that knee occasionally locks | 2-4+ |
| 24 | Fracture through the lower aspect of the articular surface, with some rotation of the smaller fragments. Many loose bodies in joint. Knock knee. Suggests Charcot's joint | Final diagnosis was Charcot's joint | Drop |

TABLE IV—FRACTURES OF BOTH TUBEROSITIES OF THE TIBIA—Continued

| Case | Extent of bone injury | Last follow-up report | Class |
|------|---|--|-------|
| 25 | Compound, comminuted, crushed fracture of the head, with knee entering the articulating surface. Good position. | 9 years after injury. Joint is ankylosed. A sequestra was removed 4 years ago. | 0-2-3 |
| 26 | Comminuted, crushed fracture of the head, with fracture knee extending onto the articulating surface. Good position. | 1 year after injury. No complaint whatsoever. No pain, weakness or limitation of motion. No preternatural mobility. | 4-4-4 |
| 27 | Crushed fracture of the tibial head, the crush especially involving the posterior part. | 10 years after injury. There is a bowing deformity with disability. Wears a walking brace while at work. | 2-3-3 |
| 28 | Outer tuberosity involved by a longitudinal line extending on to the joint surface. Inner head probably spiral fracture. Good position. | 5 months after injury. No pain. Walks without a limp. Does not favor knee. Complete freedom of motion. A preternatural mobility. | 4-4-4 |

FRACTURES INVOLVING THE ANTERIOR AND POSTERIOR PART OF TIBIAL HEAD

| | | | |
|----|---|--|-------|
| 29 | Fracture involved the anterior part of the head, with but little displacement of the fragment. | 1 month after injury. There was good symptomatic function. | 4-4-4 |
| 30 | Fracture involved the posterior part of the head, or tibial shelf. There was no displacement of the fragment. | 8 years after injury. No pain, weakness or disability. Not afraid to bear full weight. | 4-4-4 |

FRACTURES OF THE SPINE OF THE TIBIA

| | | | |
|----|--|--|-------|
| 31 | External tubercle of the spine. Good position. | 1 month after injury. No complaints. Working as a waiter. | 4-4-4 |
| 32 | Through the base of the spine, below the external tubercle. Good position. | 8 months after injury. No residual symptoms whatsoever. Did not recall which knee was injured. | 4-4-4 |
| 33 | Through the base of the spine, below the internal tubercle. Good position. | No follow-up. | |
| 34 | External tubercle of the spine. Good position. | Six years after injury. No complaint. Does not favor knee when walking. | 4-4-4 |

FRACTURES OF THE CONDYLES OF THE FEMUR

| | | | |
|----|--|--|-------|
| 35 | Comminuted fracture of the internal condyle. Slight posterior rotation, but otherwise good position. Plus a comminuted fracture of head of fibula. | 1 month after injury. Flexion limited to about 50 degrees. No pain or deformity. Slight weakness. No preternatural mobility. Walks normally. | 4-3-3 |
| 36 | Longitudinal fracture through the lower end of the femur splitting of the external condyle. Good position. | 6 months after injury there was complete return of function without pain, deformity or fixation of motion. No weakness. | 4-4-4 |
| 37 | Fracture in which a portion of the articular surface of the internal condyle was completely separated. | 5 years after injury. No pain, weakness, disability or deformity. No fear of bearing full weight. Does not favor when walking. | 4-4-4 |
| 38 | Spiral type of fracture of the outer portion of the external condyle. | 14 months after injury. Wears an elastic support about the knee. Slight weakness. Does not favor when walking. Takes part in athletics. | 4-3-4 |
| 39 | Spiral type of fracture of the medial or inner aspect of the internal condyle. | No follow-up. | |
| 40 | Spiral type of fracture of the outer part of the external condyle. | 16 months after injury. No deformity. Examination revealed no weakness, unusual tenderness, or preternatural mobility. There was no limitation of motion. According to his statement, his knee was weak, painful and wobbly. He was still using crutches. A compensation case. | 4-3-0 |

only or the internal condyle may be fractured. On whatever degree of flexion of the knee at the time of direct trauma will depend the point of contact of the femoral condyles with the tibial plateau. In flexion the posterior portion of the tibial plateau or shelf, would tend to be crushed, while in extension, the crush would be more anterior with a resultant "back knee." When to this simple mechanism one adds forcible torsion, lateral or posterior displacement, it does not require any too vivid imagination to reconstruct the forces employed in the production of these sometimes, complex fractures.

Deformity. The knee joint may be swollen, depending on the amount of effusion. A rapid swelling

would suggest intra-articular hemorrhage, and when delayed probably serous. The knee will be held in partial flexion, and further flexion or extension will be limited. Depending on the displacement of the condyles of the femur or tuberosities of the tibia will depend the degree of genu varum or valgum. For the same reason, "back knee" will depend on the downward displacement of the tibial plateau. In the absence of swelling, the degree of displacement of the bony fragments may be discerned, and especially, widening of the tibial plateau.

Preternatural anteroposterior movement might indicate rupture of the crucial ligaments. One would hardly be justified in the elicitation of this

sign without anesthesia, due to pain on motion of the injured joint. After induction of anesthesia and with muscular relaxation, one cannot be positive. Cary failed to find this anteroposterior preternatural mobility in 12 cases in which this particular point was given attention.

A positive diagnosis of frank ligamentous tear can be made by open operation. This would appear to be unjustifiable in any case. One attention is immediately attracted to those sprain fractures or osteochondral separations, marking the site of the attachment of the crucial ligaments. Wagner, Bernard, and Krida believed them to be true sprain fractures of the crucial ligaments. If this be true, it would appear that one might expect such, rather than a true tear or rupture of the crucial ligaments.

Diagnosis. It seems, therefore, in this injury that the time has come when we must depart from the methods of diagnosis based upon the careful history of injury, symptoms and physical signs. This triad has resulted in too frequent disaster through failure to make the proper diagnosis. It may seem heretic to suggest that one minimize these methods handed down to us through long periods of practice.

With the history of trauma sufficient to produce any one of the signs or symptoms of a fracture that is, deformity, crepitus, preternatural mobility, loss of function, pain, swelling or discoloration, diagnosis should be confirmed or disproved through an early and suitable roentgenological examination. Recalling that pain is usually the predominant symptom in those fractures about the knee joint, this symptom alone should lead one to X-ray examination of the part involved. Until we have had suitable roentgenological studies, and not until then are we exonerated at point of law in failure to make a fracture diagnosis.

Extent of bony injury. In the collected series of 40 cases, the character of the fractures have been tabulated to permit of some appreciation of the extent of bone damage (Table IV). A few of the fracture roentgenograms have been reproduced, the description of each bearing the case number corresponding to that in Table IV. Each plate represents the position of the bony fragments after reduction.

Varying alterations in the head of the tibia were observed. Widening of the tibial plateau was frequent. There was usually comminution due to a crushing injury. The degree of displacement was variable. In 14 of 27 patients admitted to the hospital, the position of the bony fragments was considered sufficiently good to demand no further correction.

It is probably safe to add that the degree of alteration of the tibial plateau and especially the articular facets, was never appreciated to its fullest extent, by the usual anteroposterior and lateral roentgenograms. With the knee in partial flexion an anteroposterior roentgenogram may be produced, which will show more of the detail of the tibial plateau.

Fractures of the tibial spine, though few in number were found to involve the base of the spine. It may be that those fractures at the bases represent sprain fractures of the crucial ligaments. Fractures of the tubercle could represent either a dislodgement of the semilunar cartilages, or more likely, the result of forcible contact with the mesial surfaces of the femoral condyles with which they are in close relation.

The fractures involving the anterior and posterior portions of the tibial head (Cases 29 and 30) could probably have been classed under those of the tibial spine.

Fractures of the femoral condyles were represented in their simpler form, that of the single condyle or as a sprain fracture.

Associated and related injuries. In 5 fractures of the external tuberosity of the tibia, there was an associated fracture of the head of the fibula. In 2 of the fractures of the internal tuberosity of the tibia there was also a fracture of the head of the fibula. With a total of 30 fractures of the tibial tuberosities, this incidence of 7 fibular fractures would place the frequency of fractures of the head of the fibula with the tuberosities of the tibia at about 23 per cent.

In 2 cases there was both a fracture of the tibia and femur into the one knee joint, while other associated fractures involved the humerus in 2, the bones of the opposite leg in 4, and in individual cases the ulna, the clavicle, the pelvis, the ribs, the malar and nasal bones.

Treatment. Twenty-seven patients came directly under the care of Surgical Division "C." All of these fractures were treated as surgical emergencies.

In cases in which reposition of the fragments was needed the technique was fairly simple. With the patient reclining on the fluoroscopic table and under anesthesia, traction in a longitudinal direction was made on the affected extremity. The patient was fixed to the table by means of a padded perineal post. A Collin's cloth to the ankle and passed around the waist of a third assistant furnished sufficient traction force. The operator guided by the fluoroscope attempted to mold the bony fragments into suitable position. In some this could be accomplished man-

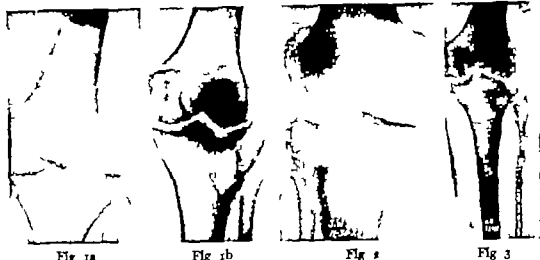


Fig. 1a

Fig. 1b

Fig. 2

Fig. 3

Fig. 1. Case 1: a Before operation b result 8½ months after operation.

Fig. 2. Case 2. Condition before treatment.
Fig. 3. Case 3. Before treatment.

usually, in others molding was aided by the application of a Spanish windlass. The latter procedure was especially applicable to those fractures about the tibial head. No more forcible measures were recorded.

Attention was particularly focused toward the replacement of the weight bearing planes to their proper relationship. In so doing any genu varum or valgum, or 'back knee' was corrected.

After reduction, lateral molded, plaster-of-paris splints were applied extending from the perineum, down to and around the foot. During their application the longitudinal traction was maintained, and the knee manipulated as little as possible. The knee was immobilized in slight flexion.

The anæsthetic employed depended largely upon the patient: open drop ether or nitrous oxide were used frequently. Recently spinal anæsthesia has been employed with much satisfaction.

None of the 40 cases recorded required open reduction.

For those patients admitted to the hospital, the average period of hospitalization was 26 days with a minimum of a day and a maximum of 95 days.

The molded plaster-of-paris splints were removed at frequent intervals to permit of care of the soft parts.

Cotton and Berg have advised against open operation in the crushing fractures of the external tuberosity of the tibia. Their closed method comprises a jamming back of the fragment to where it came from, mainly upward replacement.

Cary described elaborately his method of reduction. He did not employ the fluoroscope. Fixation was accomplished by plaster

Bernard considered fractures of the tibial spine and called attention to the necessity of open reduction when the lateral meniscus would not permit a closed replacement of the fragment.

Cubbins reported an unusual fracture in which the lateral meniscus was dislocated between the fragments comprising the external tuberosity and the head of the tibia. He advised open operation.

There are some few injuries which may be grouped with "osteitis desiccans" in which the major manifestations are those of free joint body, and in which their removal completely relieves the patients of symptoms or disability.

Cutler in a review of 38 fractures of the condyles of the femur 15 of which involved the knee joint, called attention to their successful treatment by closed methods. Fractures of a single condyle were usually replaced without open operation and maintained in a plaster dressing. Where both condyles were involved with traction and plaster he obtained good results. Further attention was called to the advice of Scudder, Speed, Cotton, and Wilson and Cochrane on this subject.

Period of disability. The termination of the average period of disability was extremely difficult. It has always appeared to be of little importance so long as the patient, some time in the near future may be assured a good and useful extremity. However, in accordance with the usual custom, an approximate idea was obtained.

The plaster-of-paris splints were usually removed at about the sixth week. Where the fracture involved the tibial head the patient was usually able to walk without the aid of a cane or crutch at about the third month. Several apparently needed the support of a cane or crutch a much longer period of time, up to 1 year. In a

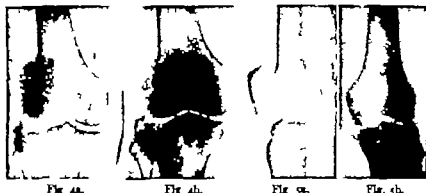


Fig. 4. Case 4. Before and after treatment

Fig. 5. Case 16. Before and after treatment.

few cases the disability was in all probability permanent though not complete (Cases 19, 25 and 27).

Complete return of function to the knee joint, as estimated on the basis of stability and strength as compared to the opposite knee joint, and absence of untoward symptoms, was evident at about the fifth month, and from then on up to as much as 2 years.

When the fracture was in the nature of a sprain fracture walking without support was possible at about the fourth month. One patient (Case 40) was using crutches after 15 months. The fact that this particular patient was receiving the benefits of a workman's compensation as a result of this injury may explain this unusual discrepancy.

If the tibial spine was involved, without fracture of the tuberosities of the tibia, the period of disability was short, 2 weeks in 1 case, and 2½ months in another.

In those fractures of the femoral condyles, the patient was able to walk without the aid of additional support, after 4 months. From that time on, up until 1 year there was complete return of function.

Swett advised 6 weeks' immobilization for fractures of the tibial head with knee joint involve ment. Ollershaw reviewing fractures of the femur as well as those of the tibial head agreed with the above period of immobilization. He further advised weight bearing after 3 months. In some of his cases 18 months were required for complete return of function.

Collins immobilized for but 1 month, which was then followed by gradual mobilization until complete recovery. His fractures were limited to the head of the tibia. Cotton permitted weight bearing in about 8 weeks.

Each fracture should be treated according to its

particular needs. As a rough guide, indeed, one may immobilize those fractures which involve the knee joint for about 6 weeks. After removal of whatever method of immobilization guided active motion may be permitted to re-establish joint motion, and to encourage return of muscular support. Weight bearing may be begun at the third month in those fractures which involve the tibial head. When the fracture involves the condyles of the femur weight bearing may be permitted after 4 months. Complete return of function is not to be expected for about 6 months, and then, depending on individual circumstances. Some may take longer as long as 2 years. After this time, one may expect that whatever disability remains, may be permanent.

Results. In order that one might correlate to some degree the extent of bone injury with the ultimate result, all cases have been tabulated (Table IV) with their last follow-up report, and classification. One (Case 24) undoubtedly a Charcot joint was omitted in the summation of these statistics. Of the remaining 39 patients, 33, or 84 per cent, were followed.

The results have been classified on the basis of complete anatomic, symptomatic, and economic recovery after the method originating at the Massachusetts General Hospital. The figure 4²⁴ represents a 75 to 100 per cent anatomical restoration. It would appear unnecessary and in fact extremely difficult to attempt a closer definition of anatomic restoration. This definition must be based on the gross appearance of the knee, its conformation and alignment. When the anatomical restoration is judged from the roentgenogram no single case would rate an anatomical 4.

Where the correct relationship of the weight bearing planes has been restored, and the patient or examiner admits of no deformity and an ab-

²⁴Double roentgenographic appearance

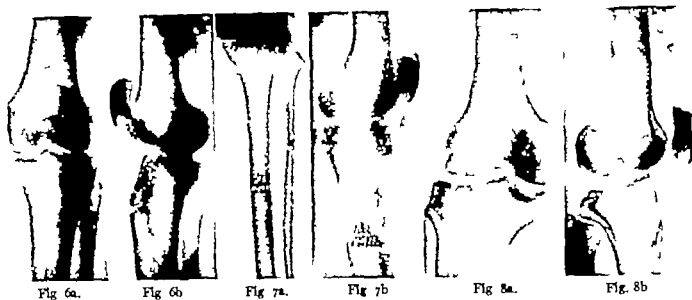


Fig. 6. Case 17. Before and after treatment.

Fig. 7. Case 25. Before and after treatment.

Fig. 8. Case 26. Before treatment. anteroposterior and lateral views.

sence or preternatural mobility one must admit of a 4? anatomical result. Where function has been completely restored in the knee joint particularly functional restoration depends in large part on anatomic restoration.

A second figure 4 represents a complete absence of symptoms, and a last 4 signifies a full economic restoration.

For example 4?-3-2 would signify 75 to 100 per cent anatomic restoration, 50 to 75 per cent symptomatic relief and from 25 to 50 per cent economic recovery.

The follow up reports are summarized for each type of fracture.

External tuberosity of the tibia. Of 15 patients 12 were followed. Eleven of the 12 or 91 per cent presented 4?-4-4 results.

Internal tuberosity of the tibia. Seven out of 8 patients were followed. Three or 43 per cent, presented 4?-4-4 results.

Fractures of both tuberosities. All 4 patients were followed. Two cases presented 4?-4-4 results. One case (Case 25) represents the result of a compound fracture. Another case (Case 27) undoubtedly represents a fracture wreck, the result of too early weight bearing or poor fixation.

Fractures of the anterior and posterior portion of the tibial head and the spine. Five patients reported and all presented 4?-4-4 results. All represented good anatomical reposition of the bony fragments.

Fractures of the condyles of the femur. Five of the 6 patients reported. But 2 at this time presented 4?-4-4 results. To this group it would appear fair to include 2 cases (Cases 35 and 38),

which after a longer period of convalescence may be expected to report more favorably. One case (Case 40) a sprain fracture, hobbling about on crutches after 15 months, represents a gross failure on the part of the workmen's compensation.

The follow up reports have been considered from the standpoint of their relationship to a good anatomical restoration of the bones involved or to a poor anatomical restoration.

In the fractures of the external tuberosity of the tibia, 5 showed a good anatomical reposition of the bony fragments in the post reduction roentgenogram. All practically have presented 4?-4-4 results. One at 5 months had slight pain on walking. In 7 fractures, in which the post reduction roentgenogram showed but a poor anatomical reposition of the bony fragments, all reported favorably.

In those fractures of the internal tuberosity of the tibia, 6 showed a good reposition of the bony fragments in the postreduction roentgenogram, 5 of which to all practical purposes presented 4?-4-4 results. Two have been reported at 10 months, and 1 year prior to the completion of convalescence. In but 1 fracture, where a poor anatomic restoration was recorded by the post reduction roentgenogram (Case 19) the ultimate result was poor.

For the entire group of 33 patients followed, 4?-4-4 results were recorded in 70 per cent. With a longer period of convalescence in a few patients a better report may be expected. Of the remainder with the exception of the patient (Case 25) who suffered a compound fracture there were only minor deformities a few symptoms in the



Fig. 9a

Fig. 9. Case 37. Before and after treatment.



Fig. 10a

Fig. 10. Case 35. Before treatment.



Fig. 11a

Fig. 11. Case 36. Before treatment.



Fig. 12a

Fig. 12. Case 36. Before treatment.



Fig. 13a

order of occasional pain, or weakness and instability of a lesser degree, and but slight economic impairment as a result of the injury. There were no cases of non union. One case (Case 23) had a resultant loose semilunar cartilage.

In several patients the follow up data has extended beyond a period of 5 years (Cases 1, 7, 15, 16, 20, 21, 27, 30, 34, and 37). In none of these could the ultimate results have been interpreted as being complicated by an arthritis. All of these with but 2 exceptions (Cases 23 and 27) presented 47-4 results. Attention has been called to the occurrence of chronic arthritis by Collins.

SUMMARY

A series of 40 fractures of the tibial head and femoral condyles has been presented. All were treated by closed methods. None were reduced at open operation. For those patients admitted to the hospital, treatment mainly consisted of an early fluoroscopically controlled reduction, under a selected anesthetic. Immobilization was accomplished with molded plaster-of-paris splints. Splints were usually removed at the end of 6 weeks. Weight bearing was permitted at about the third month in those fractures of the tibial head. Weight bearing was permitted at about the fourth month in those fractures of the condyles of the femur. Complete return of function was observed at about the sixth month, and on up to the second year.

Eighty four per cent of 39 fractures were followed. Seventy per cent presented 47-4 results.

On the basis of this data it appears justifiable to conclude that the closed method for the treatment of fractures of the tibial head and femoral condyles, which enter upon the knee joint, offers satisfactory results in even particularly severe in-

juries, where attention is paid to early reduction, with individual judgment as to the need of a cabinet maker's restitution of fragments, followed by ample protection during convalescence.

CASE 2. E. I., female, aged 33 years. X-ray examination showed a comminuted, crushed fracture of the head of the left tibia, with spacial involvement of the external tuberosity and considerable widening of the joint surface. The head of the fibula was likewise fractured (Fig. 13a).

Sixteen months after the injury the patient wrote that she felt no ill effects from the fracture. She was examined about 8 1/2 years after fracture. She walked without a limp. There was no limitation of motion, nor was there preferential mobility. She suffered no pain either when weight bearing or walking. She stated that when walking up stairs, she tended to favor the left knee slightly.

X-ray examination at this time showed the fragments united in good position (Fig. 13b).

Class—47-4-4.

CASE 2. J. W., male, aged 35 years. X-ray examination showed a comminuted, crushed fracture of the external tuberosity of the head of the left tibia, with widening of the tibial plateau (Fig. 2). Lateral molded plaster splints were applied 2 days later. He was discharged from the hospital seven days after injury. The splints were in place, and he was up on crutches.

No follow-up.

CASE 3. H. G. male aged 33 years. X-ray examination showed a comminuted, crushed fracture of the external tuberosity of the left tibia, involving the articular surface as far as the spine. In addition there was a comminuted fracture of the head of the fibula, with comminution of the shaft (Fig. 3). Approximately thirteen months after injury he was doing light farm work, and although he stated that his knee was weak and wobbly he was able to walk upstairs without difficulty.

In reply to a questionnaire about 4 years after injury the patient stated that it was fully 2 years before his knee appeared to be as strong as it was prior to the fracture. There was no pain, unusual weakness or swelling. He had no deformity. He was not afraid to bear full weight. He added, that, after hours of unusual strain, like a long walk over the hills and through the woods over rough ground, the knee would feel a little lazy and tired, but would fully recover in an hour.

Class—47-4-4.

CASE 4. G. McB., male aged 50 years. X-ray examination showed a comminuted, crushed fracture of the external tuberosity of the right tibia, with considerable widening of the joint surface and irregularity in contour. The posterior aspect of the external tuberosity was depressed. There was in addition, a comminuted fracture of the right humerus at the junction of the lower and middle thirds, with marked anterior bowing, but otherwise good position (Fig. 4a). Four and a half months after injury the patient walked with the aid of a cane. He had no limitation of motion, nor was there preternatural mobility.

Seven and a half months after fracture there was good anatomic restoration, with a good symptomatic and economic recovery.

Class—4-2-4-4.

CASE 16. J. B., female, aged 55 years. X-ray examination showed a comminuted fracture of the plateau of the internal tuberosity, of the left tibia, with the fragments in good position (Fig. 5). Approximately 2 years later she presented a complete recovery with a good anatomical, symptomatic, and economic result. Approximately 5 years after fracture she stated that she had no discomfort or interference with function whatsoever. There was no deformity. She walked without a limp. She did not tend to favor that knee.

Class—4-2-4-4.

CASE 17. V. R., male, aged 47 years. Ten months after injury the patient presented himself to the Surgical Out Patient Department with the complaint of pain on walking. X-ray examination showed an oblique fracture of the upper end of the tibia, extending from the internal aspect of the shaft, upward to involve the articulating surface. There was a similar fracture of the upper end of the fibula. The fragments had united in good position (Fig. 6).

Class—4-2-3-3.

CASE 25. M. S., female, aged 56 years. X-ray examination showed a comminuted, crushed fracture of the head of the tibia on the left side with the fracture lines entering onto the joint surface. The fragments were in good position (Fig. 7).

In reply to a questionnaire, approximately 9 years after the fracture, the patient stated that the knee joint was completely ankylosed. A sequestra had been removed 4 years ago.

Class—0-2-3.

CASE 26. R. R., male, aged 33. X-ray examination showed a fracture of both tuberosities of the right tibia, with the fracture lines extending into the knee joint. The fragments were in good position (Fig. 8). At 3 months, and at 1 year after the fracture, the patient presented a good anatomical, symptomatic and economic result.

Class—4-2-4-4.

CASE 27. C. G. male aged 45 years. X-ray examination showed a crushed fracture of the tibial head, with the fragments in good position (Fig. 9a). In reply to a questionnaire about 10 years after injury the patient stated that he was wearing a walking brace. There was no pain, weakness, or wobble nor was he afraid to bear full weight.

He limped, however and there was a persistent bow of the injured knee.

Class—2-3-3.

CASE 33. R. C. male aged 16 years. X-ray examination showed a fracture of the articular surface at the base of the inner tubercle of the spine. There was no displacement of the fragments (Fig. 10). Examination of the patient about 9 months after injury showed a full anatomical, functional and economic recovery. He stated that his knee joint was as strong as its fellow as early as 2½ months after injury. He was not afraid to bear full weight on that knee, nor did he favor it when walking.

Class—4-2-4-4.

CASE 35. W. C. male aged 54 years. X-ray examination showed a comminuted fracture of both bones of the left leg below the knee joint. There was a comminuted fracture of the internal condyle of the right femur with the fragments in good position. There was, in addition, a comminuted fracture of the head of the right fibula, the fragments likewise in good position (Fig. 11). At follow up 4½ months after injury he was able to walk without the aid of a cane or crutch. Examination about 5 months after the fracture showed that flexion of the knee joint was limited to about 30 degrees. The joint was not as strong as it had been prior to injury. There was no pain and the patient was not afraid to bear full weight upon it. He did not favor that joint when walking. There was no deformity. He observed occasional soft tissue swelling.

Class—4-2-3-3.

CASE 36. F. P., male, aged 48 years. X-ray examination showed a longitudinal fracture of the lower end of the shaft of the left femur with a splitting off of the external condyle. The fragments were in excellent position (Fig. 12). At follow-up 6 months after injury the patient presented a complete return of function. There was no deformity, weakness, pain or limitation of motion.

Class—4-2-4-4.

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THE PATENCY OF BILIARY DUCTS

DETERMINED BY RADIOPAQUE OIL INJECTED THROUGH A T TUBE PREVIOUSLY PLACED IN THE COMMON BILE DUCT FOR THE PURPOSE OF PROLONGED DRAINAGE

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AS HAS been pointed out, prolonged drainage of the biliary tract is advisable under certain conditions, such as removal of stones from the common bile duct infection and suppuration in the biliary tract and reconstruction of the duct over a T tube. Whenever the common bile duct is opened for any purpose, a tube should be left in the duct. If a T tube is employed complete control of the flow of bile can be maintained the bile may be allowed to discharge freely to the outside through the long arm of the T tube or it may be forced into the duodenum by clamping off the tube. In certain instances drainage by this method has been continued for as long as a year. We have not had the experience of having a stricture of the duct follow the procedure and if the duct is patent there is no danger that a biliary fistula will persist after the tube is removed.

It is always desirable to know just what has taken place in the biliary tract and whether the ducts are patent, before removal of the tube is considered. From a clinical standpoint, this can be determined fairly accurately. One can be sure that the duct is patent if there is no discomfort in the upper part of the abdomen, no jaundice observed either clinically, or by tests of serum if the stools are of normal color and if there is no leakage around the tube during the time that it is clamped off. However in certain instances, although the ducts are wide open, only a small quantity of bile will be discharged. This is indicative of the degree of hepatic injury that has occurred. The jaundice will be slow to subside, and the stools will be slow to take on a normal color. Any measure that can be carried out that will give a better understanding of the whole situation will be advantageous.

In the past, visualization of the common bile duct was possible only occasionally if there was a reflux into the biliary tract after an opaque meal. Sometimes other biliary radicals were seen. Venable and Briggs reported 2 cases of visualization of the biliary ducts after a barium meal. In 1 of these a stone in the common bile duct had trapped some barium above its level in the duct. In the other case there was obstruction high in the jejunum and medium was forced into the

common bile duct, gall bladder and some of the biliary radicals. Visualization has also been made possible by injecting medium through a tube placed in the gall bladder or in the stump of the cystic duct after cholecystectomy. Sometimes, following the Graham-Cole test, both the gall bladder and the common bile duct are visualized.

A new method of studying the biliary tract was suggested to Gabriel by the publication of Ginsburg's and Benjamin's study of biliary fistula by the injection of lipiodol. Gabriel injected a radiopaque oil through the T tube that had been placed in the common bile duct for drainage. Overholt employed this method, and reported results in a series of cases. With this procedure it is possible to prove definitely the patency of the ducts while the T tube is still in position. Sometimes the medium reaches the smaller biliary passages, and an opportunity is given to visualize these radicals and obtain a better understanding of the existent pathological processes.

We have used this method in 40 cases. The patient is placed under the fluoroscope and the radiopaque oil is injected thus the passage of the medium through the biliary tract may be watched. It is not wise to carry out the procedure if patients have recently had chills or fever. The patients in our series have all been ambulatory. In no instance have injections been made earlier than 2 weeks after operation. Although the literature contains an occasional report of ill effects from the procedure, we have not had such experience. After the fluoroscopic examination, more of the medium is injected into the tract through the T tube and a flat plate of the abdomen is made. In some cases we have used as much as 15 to 20 cubic centimeters of the solution.

If the liver has not been injured, and the common bile duct is not obstructed, the medium will flow into the duodenum so freely and so quickly that visualization of the biliary radicals is not possible. The following case is illustrative.

CASE 1: A woman, aged 38 years, gave history indicative of chronic cholecystic disease, existing for several years. Operation revealed chronic cholecystic disease, lithotic stones. The common bile duct was thick walled and



Fig. 1. Radiopaque oil injected through T tube which was placed in common bile duct 3 weeks previously. The distribution of this medium reveals that the ducts are patent.



Fig. 2. Radiopaque medium injected in dilated common bile duct, fills the duct, there is no medium in bowel. The biliary tract was drained by T tube for 6 months after removal of stones from the common bile duct.

about three times normal size. When it was opened, the bile appeared normal, but was under some tension. No calculi, but definite cholangitis was present. A T tube was inserted into the duct for the purpose of prolonged drainage of the biliary tract, and cholecystectomy was performed. The tube was left in place for 3 weeks, and before its removal, opaque medium was injected into the tract, this revealed that the ducts were patent, since the oil flowed freely into the duodenum, and there was no evidence of its presence in the biliary tree when a flat plate of the abdomen was made (Fig. 1).

If the function of the gall bladder has been completely destroyed by disease there will usually be dilatation of the common bile duct and other biliary radicals. This may even be more manifest if there is also obstruction of the duct, such as is caused by stone. Insertion of the medium in these cases will show the dilatation of the duct and often some of the medium will reach the smaller biliary radicals. This is illustrated in the following case.

CASE 2. A man, aged 42 years, had had recurrent attacks of pain in the right upper quadrant of the abdomen for 20 years. Jaundice was sometimes present. A diagnosis was made of chronic cholecystitis with cholelithiasis and stone in the common bile duct. At operation it was found that the gall bladder was large and cystic, and that its function had been completely destroyed. The common bile duct was dilated and contained calculi. There was stony material in the ampulla of Vater. Cholecystectomy was performed and after removal of the debris from the common bile duct, a T tube was inserted for prolonged drainage, it was removed at the end of a month. After the patient had gone home he had two severe attacks of pain in

the right upper quadrant of the abdomen without jaundice. Eight months later he returned because of further attacks. A second operation revealed that the common bile duct was thick walled and dilated to about four times normal size. The bile in the duct was under some tension. One large stone and several smaller ones were removed, after which a tube passed readily into the duodenum. A T tube was placed in the duct to insure free prolonged drainage. After it had been in place 6 months, radiopaque oil was injected through the T tube and the ducts were found to be markedly dilated, but patent. Some of the medium even entered the smaller biliary radicals. There had been no recurrence of symptoms, and no discomfort on clamping off the tube for as long as 24 to 48 hours. The patient felt that he was in good condition. We were certain that the ducts were patent, and that the opening in the duct would close promptly after removal of the tube. This proved to be the case (Fig. 2).

In 1 case the greater part of the biliary tree was well visualized including some of the smaller radicals, yet there was no obstruction to the flow of the medium into the duodenum. The common bile duct was open. The wide dispersal of the medium through the biliary tree was undoubtedly made possible by the compensatory dilatation. Intermittent obstruction of the duct by stone over a period of years had undoubtedly increased the dilatation.

CASE 3. The patient, a man aged 34 years, had had severe colic in the right upper quadrant, associated with chills and jaundice over a period of years. Two years before our examination, his gall bladder had been drained, with temporary relief of symptoms. One year later cholecystogastrostomy was performed without relief. During



Fig. 3. T tube drainage of common bile duct for 3 months following removal of stones. medium injected through T tube flows freely into duodenum, the biliary tree is well visualized.



Fig. 4. Common bile duct drained for 3 months with T tube following removal of stones from the ampulla, injection of radiopaque medium revealed that duct is obstructed, lateral choledochoduodenostomy was necessary 19 months later.

this period he had become addicted to morphine because of continuance of the colic-like pain and the associated jaundice. A diagnosis was made of stone in the common bile duct. Exploration disclosed that the gall bladder was anastomosed to the stomach. The anastomosis was disconnected and the opening in the stomach closed. The common bile duct was then opened. It was filled with foul bile under tension, many small stones, and much mucus.

After removal of the calculi, a curved forcep passed readily into the duodenum. A T tube was placed in the duct for prolonged drainage, and a dressed tube was stitched into the gall bladder. The liver was infected, and there was rather extensive enlargement in the head of the pancreas. Five and a half months after this operation, the patient returned. He was in good condition. There was no external drainage through the long arm of the tube, no jaundice, and stools were of normal color. The ducts were studied by injection of the opaque medium and found to be patent. The tube was then removed from the duct without difficulty. There was slight drainage of bile afterward, but the patient was able to start for home the following day. He reports that he has remained well (Fig. 3).

Should discomfort arise on clamping off the external branch of the T tube, or should jaundice increase, one can be reasonably certain that there is some obstruction in the duct. The use of radiopaque oil will disclose the condition, which is illustrated by the following case.

CASE 4. A man, aged 63 years, had had cholecystectomy performed in 1930 because of cholelithic disease with stones. He came to the clinic 7 months later with an external biliary fistula and obstructive jaundice, which was due to a stone in the common bile duct. In spite of the

drainage of bile to the outside, the jaundice had persisted. At operation, it was found that the liver was slightly atrophic. The common bile duct was tremendously dilated and easily admitted the first finger. Stony material was removed from the ampulla of Vater. There was some inflammation in the tissues at the lower end of the common bile duct. The head of the pancreas was enlarged. The right hepatic duct was not seen. A T tube was inserted into the common bile duct with the idea that it was to remain until the jaundice subsided. It was thought at the time that lateral anastomosis between the common bile duct and the duodenum might be necessary later. However, we were sure the duct was open at times, since bile was recovered from the duodenal contents. Injection of the opaque medium through the T tube showed that the duct was tremendously dilated.

The T tube was removed 2 months after its insertion. The fistula gradually closed. Nineteen months after removal of the tube, lateral anastomosis between the duodenum and the common bile duct was necessary on account of jaundice and colic. Posterior gastro-entrostomy was made at the same time because of impending duodenal obstruction (Fig. 4).

CONCLUSIONS

We feel that this method of determining the patency of the common bile duct affords a better understanding of postoperative conditions in the biliary tract which have necessitated drainage by the T tube. Should obstruction exist, its extent can often be ascertained. If the ducts are found to be patent, it may be assumed that there will be no external drainage on removal of the tube. Thus knowledge concerning individual cases will be

more complete and the final results can be more definitely estimated.

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CARCINOMA OF THE CERVIX UTERI

FIVE YEAR RESULTS OF RADIUM TREATMENT

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THE recent request of the American College of Surgeons for details of the results in cases of malignant disease treated in 1924-25-26 furnished the occasion for this series of cases. This report deals with 79 cases of carcinoma cervix uteri treated by me with radium during the years 1924-25-26, all of which were proved by histological examination of biopsy specimens.

CLINICAL RECORD

The histories recorded in these cases showed the usual complaints of vaginal bleeding vaginal discharge, and occasionally some pain. The age incidence however was of some interest. The greatest number of cases, as is usual occurred between the ages of 41 and 55 years. The youngest patient treated was 26 years there being 3 of this age. The youngest 5 year cure was 37 years of age there being 3 of this age. The figures regarding the number of pregnancies were not remarkable except that 10 per cent of the patients had never been pregnant. This percentage was almost identical with that reported by me (3) in an earlier series of cases.

A special effort was made to determine the delay in consulting a physician, the responsibility for such a delay being the patient's and the delay in satisfactory treatment after a physician's advice this delay being at times the responsibility of the patient and at times that of the physician. The average delay in consultation was 2.6 months. The shortest total delay was 3 days and the longest total delay 3 years, the average total delay for the entire series being 8 months. This last figure is particularly interesting as the

average total delay for the 5 year cures was 4.8 months. These figures emphasize the necessity for prompt treatment if permanent cures are to be obtained.

EXAMINATION

These cases were classified according to the original classification used by the American College of Surgeons (1) primary case (2) recurrence in vaginal wall following panhysterectomy for cancer (3) recurrence deep in pelvis following panhysterectomy (4) carcinoma of cervix following supracervical hysterectomy

(A) Disease limited to cervix (B) disease involving uterine cavity or vaginal wall (C) disease involving broad ligaments (D) wide fixation, remote metastases.

Most of our cases were classified as 1 B C involvement both of the vaginal wall and broad ligaments being present in most of them. In addition a + or - was added to this classification, + meaning a proliferative and - a destructive growth. A typical + case was a papillary growth filling the upper vagina. A typical - case was crater formation with no projecting cervix. These extremes were easy to classify but all cases, even those where proliferation or destruction was not marked have been classified according to the opinion of the operator at the time of treatment, as either + or -

DETAILS OF TREATMENT

Glass seeds were used for all implantations and X ray was used to supplement the radium only in 9 of the 79 cases. This technique has now been

changed by using gold radon implants and usually by the addition of X-ray treatment after the radium treatment, but the figures given are based on the old method of treatment. A typical radium treatment consisted of one 75 milligram tube, screened with 0.5 millimeter silver 1 millimeter brass, and 1.5 millimeters rubber or aluminum, applied within the cervical and uterine canals for 36 hours, making a dosage of 75×36 equals 2700 milligram hours. In addition the cervix was implanted with 12 1 millicurie glass implants of radon making an additional dosage of $12 \times 1 \times 132$ equals 1584 millicurie hours or a total dosage of $2700 + 1584$ equals 4284 milligram and millicurie hours or 32.45 millicuries destroyed. The maximum dosage was 10,464 milligram hours, the average dosage being 4287 milligram hours, corresponding very closely to the typical dose given above. The largest dose in the series of 5 year cures was 7248 milligram hours, the average dose being 4428 milligram hours.

Seventy-seven and two-tenths per cent of the patients received one radium treatment, 16.5 per cent received two radium treatments, and 6.3 per cent received three treatments. Of the 5 year cures 76.9 per cent received one treatment, 23.1 per cent two treatments, there being no 5 year cures among the patients receiving three treatments. I believe that it is useless to try to accomplish too much by increasing the radium dosage.

COMPLICATIONS

Of the complications following treatment the development of fistula alone has been analyzed. Two patients developed rectovaginal fistulae and 4 developed vesicovaginal fistulae. One patient developed both rectovaginal and vesicovaginal fistulae. This patient, however had diabetes which may have been a factor in causing excessive necrosis after irradiation. Three of the vesicovaginal fistulae developed in patients where the tumor was originally classified as 1 D — primary cervical growth with wide fixation and crater formation. In all of these the pre-operative examination showed rather marked involvement of the bladder wall and the fistula was probably an inevitable complication independent of the treatment, as these patients each received a single small dose of radium. The two rectovaginal fistulae occurred in patients where the growth was classified as 1 B C +. In both of these three radium treatments had been given in the endeavor to control a bulky growth which would not respond well to treatment. In these cases the repeated irradiation may have been a cause of the fistula.

RESULTS

An effort was made to establish some connection between the + and — classification and prognosis. The average duration of bleeding control in the + cases was 30.4 months, and in the — cases 18.9 months. The average duration of life after treatment in + cases was 35.5 months and in — cases 21.4 months. Eight of 13, 5 year cures were classified as + and 5 as —. This would seem to indicate a better prognosis in the + cases.

Of the 13, 5 year cures 3 were classified as 1 A, 6 as 1 B C, 1 as 1 D, 1 as 2 B, 1 as 4 B, and 1 as 4 B C. There were 3, 5 year cures among 5 patients classified as 1 A, the definitely operable group in the old statistics.

The 5 year cures for each year were as follows: 1924 series (17 patients, 1 cure) 5.8 per cent, 1925 series (25 patients, 4 cures) 16 per cent, 1926 series (37 patients, 8 cures) 21.6 per cent. This gives 16.4 per cent of 5 year cures for the entire series of seventy nine cases. In computing these percentages all untraced patients were included and counted as dead.

HISTOLOGICAL CLASSIFICATION

Histological grading of the entire group was made according to the criteria of Martzoff. In 69 instances the grading was made directly from the microscopic sections and in 10 instances, in which the sections were not available, the microscopic descriptions were deemed adequate for grading. In applying the criteria of Martzoff it was recognized that there was a certain degree of overlapping of the groups and in such cases the dominant cell type determined the group. Group I was comprised not only of tumors which were keratinizing and tumors containing prickly cells, but also all of those in which the cells resembled those of the upper layers of cervical epithelium. Group II consisted essentially of transitional cell tumors, although many of them were more or less differential in certain portions. Group III included undifferentiated tumors, many of which were composed of spindle cells, while others were so completely anaplastic as to be best characterized as carcinoma simplex. Adenocarcinomas were grouped separately but were not given a group number.

CONCLUSIONS

Table I shows the total delay in treatment, the duration of bleeding control and the duration of life after treatment in all cases classified according to the cell differentiation.

*I am indebted to Dr. Alan R. Martzoff of the Institute of Pathology of Western Reserve University for the histological grading of these tumors.

POMEROY CARCINOMA OF THE CERVIX UTERI

TABLE I

| Cell group | Cases | Delay months | Bleeding control months | Life months |
|--------------------------|-------|--------------|-------------------------|-------------|
| Well differentiated. | 3 | 6 | 24 | 31 |
| Partially differentiated | 38 | 8 | 19 | 90 |
| Undifferentiated. | 13 | 9 | 3 | 23 |
| Adenocarcinoma. | 5 | 1 | 43 | 48 |

Table II shows the 5 year cures grouped according to the cell differentiation.

TABLE II

| Cell group | Cases | No. of 5 year cures | Per cent of 5 year cures |
|--------------------------|-------|---------------------|--------------------------|
| Well differentiated. | 23 | 4 | 17.3 |
| Partially differentiated | 38 | 5 | 13.1 |
| Undifferentiated. | 12 | 1 | 8.3 |
| Adenocarcinoma. | 5 | 2 | 40 |

It must be borne in mind that the variation in group survival is not alone an index of the inherent malignancy of the histological types, but also an index as to their susceptibility to radium. According to Martzloff the undifferentiated cells compose what is inherently the most malignant group and his follow up records indicate that to be true in cases treated surgically. Healy and Cutler however, show much better results in advanced cases of the undifferentiated cell group than in advanced cases of the well differentiated cell group where the patients were treated by irradiation.

SUMMARY

- 1 In a series of 79 cases no 5 year cures were obtained in patients below the age of 35.
- 2 The average total delay before cure was 4.8 months in the 5 year cures with 8 months in the entire series.
- 3 The gross examination was the single aid in estimating the prognosis. Good results being obtained in cases where disease was limited to the cervix, the cure being made early and treatment started.
- 4 The proliferative tumors gave better results than the destructive tumors, as to bleeding control, duration of life, and 5 year cures.
- 5 The 5 year cures by years were: 1924, 5.8 per cent 1925, 16 per cent 1926, 16 per cent.
- 6 The degree of cell differentiation has little influence on the percentage cures obtained in each group. However, results, 2, 5 year cures among 5 year cures were obtained in the adenocarcinoma.

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EARLY RECOGNITION OF ILIOPECTINEAL BURSTITIS

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ILIOPSOAS or more properly Iliopectineal bursitis has been recognized since 1834 (13).

At least, medical history recorded its recognition at that time. In 1925 when a survey of the literature on this subject was made by Gatch and Green only 33 cases had been recorded. Since 1925 4 additional cases have been reported. It would seem, therefore, that the condition is of infrequent occurrence, but a consideration of the reported cases in the light of our knowledge concerning bursae forces one to the belief that the reported cases represent only those lesions of the iliopectineal bursa which had progressed to a point where surgical measures were deemed necessary as treatment and, incidentally, made the recognition of the condition possible.

The length of time for which the symptoms of the condition existed before the correct diagnosis was made (2) is, in itself, an indication that the condition may exist unrecognized for many years.

The desirability of early recognition of the lesion when it is present is important for several reasons. The proximity of the iliopectineal bursa to the hip joint and the symptoms common to lesions in both the bursa and the joint render a correct diagnosis desirable, if not imperative, when the question of surgical interference arises. The proximity of the iliopectineal bursa to the inguinal and femoral rings undoubtedly has resulted in many herniotomy operations on a faulty diagnosis with failure to relieve the symptoms.

The condition is intractable under the most intelligent treatment and, if undiagnosed, is most unlikely to receive adequate treatment. Then too in the field of traumatic surgery in which field most of the lesions of this bursa may be found, prognosis is important and an intelligent prognosis cannot be given if the true lesion is not recognized.

HISTORICAL

The first case of Iliopectineal bursitis reported was from Germany by Fricke in 1834. The patient was a carter and the pain was referred to the knee. In 1847, Joly reported a case and wrote what is still one of the outstanding papers on this condition. The right diagnosis was made in this case before operation. In 1859, Chamaignac reported a case in which cure was obtained by injection of equal parts of water and iodine. In

1868, Heineke reported the first case in a female and noted that active motion of the hip was limited and weak, while passive motion was free and painless. An additional case was added in 1873 by Rose. In 1880 Charleston removed a cyst which extended from within the pelvis down to the knee. The extent of this cyst has caused some writers to exclude this case from the series. In the same year Schaeffer reported a case which seemed to have its origin in an injury 2 years previously. Prengueber in 1885 reported a case, the tumor mass of which interfered with motion in the hip caused pain along the course of the anterior crural nerve and extended up beneath Poupert's ligament. In the same year Baker reported a case having symptoms for 9 years. In 1887 Sprengel reported a case in which the bursa communicated with the hip joint. Two years later Hoffa reported a case in which the limb was in partial flexion, slightly abducted and externally rotated. Motion in the opposite directions was limited and painful. Mondais, about the same time, pointed out the communication between the bursa and the hip joint. In 1891 Dagron reported Le Dentin's case in which infection developed and extended to the hip joint through a communication, causing the death of the patient. Sonneborn added a case in 1894 and the following year Durville, in a study of the condition, pointed out that weakness of the limb might be a symptom of the condition and that the referred pain to the knee was due to the relation of the enlarged bursa to the anterior crural nerve. Mommaen, about the same time, reported 2 cases in 1 of which the femoral artery was pushed for ward. Zuelzer writing on "Diseases of the Bursa of the Hip" in 1899 gave injury as the etiology in the majority of cases and regarded syphilis and rheumatism as contributing factors. De Weck and Duprex in 1900 found an enlarged bursa containing several chondro-ossous bodies. Delbet reported similar findings in 1902. Lund reported 3 cases in the same year and gave the results of his study of the bursa in 18 cadavers. He found the bursa to extend up over the brim of the pelvis in 50 per cent of the specimens examined. Cullen, in 1910, found cartilaginous plaques in the wall of a cyst which was very large and occupied a large space in the abdomen. Pisano, in 1913, found his specimen to have an endothelial lining.

Kummer found edema and varicos as a result of the pressure of the tumor on the venous trunk in front of the hip. In 1925, Gatch and Green collected 32 cases from the literature and added 1 case. They found 23 of the 32 to be of the traumatic or non-infectious variety. They classified the cases as pyogenic, tuberculous, syphilitic, and cystic. They further pointed out that symptoms may be present for years before the appearance of a tumor. Additional cases were reported by Ehrlich, by Chastenot de Gery in 1928, and by Sorrel and by Hammesfahr in 1929. Volkmann, Maisseuneuve, Couteaud, Hardtman, Auray, Wood and Ehrle have reported cases as well.

ANATOMY

The bursae are not regarded in the fields of medicine and surgery as of any great importance, and they are in reality comparatively unimportant from a purely anatomical or surgical view point.

From an economic viewpoint, and in spite of us that viewpoint is acquiring greater and greater force in medicine, the bursae are important because lesions of bursae give rise to pain, the bursae are most commonly contiguous, and indispensably related, to joint motion and the proneness of bursal lesions to chronicity renders them a potential factor for prolonged disability unless promptly recognized and adequately treated.

One who has suffered from a lesion of the sub-acromial bursa will I am sure, hold that bursa in a respect entirely out of proportion to its size or comparative surgical importance.

The following case illustrates the failure of the profession to recognize iliopectineal bursitis and the prolonged disability

J J H., aged 32 years, pressman, was referred to me on January 13, 1930 with a complaint of pain in the right thigh of about 5 years' duration. The onset was sudden, immediately following an incident while at work. He was standing near a printing press with his right foot on the step of the press and was leaning forward to get a "form" which was being passed up to him from a lower level when his foot slipped off the step straining the front of the right hip. The pain was sufficiently severe to cause the patient to consult a physician the same day. The physician could find nothing on physical examination and had a roentgenogram of the hip which was entirely negative. The patient was disabled for 1 week and returned to his employment but was conscious of some remaining difficulty in the region of the hip. Following this injury the patient was disabled for several days at a time at irregular intervals because of a recurrence of the trouble. The pain complained of originated in the front of the right hip and radiated down to the knee cap. The patient noticed that the leg was "clumsy" and dragged causing him to stumble when he was tired.

The patient consulted various regular and irregular practitioners of medicine and used many forms of treatment without relief.

Examination disclosed a point of tenderness just below Poupert's ligament about midway between the anterior superior spine of the ilium and the symphysis pubis and just lateral to the femoral pulsation. The thigh was held in external rotation and slight adduction. Internal rotation and abduction were limited and painful. Hyperextension of the body on the hip and hyperextension of the right hip on the body caused pain in front of the hip radiating down to the knee. The right thigh showed 1 inch atrophy in circumference. The psoas muscle power was markedly weakened. The blood findings were normal. The roentgenograms were normal. A diagnosis of chronic, non-infectious iliopectineal bursitis was made and the patient treated by rest and heat to the hip with eventual complete relief of symptoms.

A surgeon who has had occasion to treat many lesions of the subacromial bursa does not depend too greatly upon a beneficent nature for a favorable result.

The work of Codman in bringing the subacromial bursa into prominence is even today not too well known nor too greatly appreciated. The iliopectineal bursa, in which we are interested at this time, has been spoken of by Osgood as the largest bursa in the body. Apparently, it varies in size between wide limits. Even the fact that the bursa exists is not too well known, and a brief description of it at this time seems desirable. According to Joessel, the iliopectineal bursa, or the bursa mucosa subiliaca, lies between the partly tendinous portion of the iliac muscle and the front of the iliopectineal eminence. Anteriorly, it is firmly attached to the iliopectineal muscle, posteriorly to the pectineal eminence, and likewise to the thin portion of the capsule of the hip joint. It is bounded on the outer side by the iliofemoral ligament, below by the pubofemoral ligament, and on the inner side by the cotyloid ligament. Occasionally the fibrous capsule at the thin point is lacking and again the synovial membrane may be lacking so that there is direct communication between the bursa and the joint.

In 1927 Kessel published an unusually complete anatomical study of this bursa which is well worth reading in the original publication. He concluded that the bursa appeared early in life, and proved that it was present in an embryo of 25 75 millimeters.

With reference to the communication between the hip joint and the bursa, he found the communication existing in 15 per cent of 535 adult anatomical specimens. The existence or non-existence of the communication between the hip joint and the bursa is of great surgical importance. In aspiration of the hip joint, the point for the introduction of the needle corresponds to that

SUMMARY OF CASES

| Name Age | Occupation | Symptoms | | | Signs | | | | Pain on | | Side affected | Tentative diagnosis | Treatment | Result | Accident cause |
|---------------|--------------|----------|----------|----------|-------|-------------|----------|------------|---------------|----------------|---------------|-------------------------|-------------------------------|-----------------------|---|
| | | Pain | Weakness | Swelling | Tumor | Fluctuation | Location | Tenderness | Active motion | Passive motion | | | | | |
| F.H. 37 | Fireman | P | P | P | N | M. | M | P | P | P | R. | Bursitis | Rest | Relieved | Sprain of hip |
| R. Dahl 40 | Laborer | P | P | N. | N | M | M | P | P | P | L. | Bursitis | Rest—heat | Relieved | Lifting |
| M.M. 45 | Laborer | P | P | N. | N | M. | M | P | P | P | L. | Bursitis | Rest—heat | Relieved | Strike of hip |
| J.S. 7 | None | P | P | N | N | N | M | P | P | P | L. | Bursitis | Rest—heat | Relieved | Focal infection |
| A.B. 7 | Student | P | P | P | P | M. | P | P | P | P | R. | Serpy hip | Injection and drainage of hip | Ankylosed hip | Gymnasium work |
| V.B. 9 | Student | P | P | M | N | N | N | P | P | M | R. | Bursitis | Rest—massage trailing | Relieved | Automobile collision |
| C.D. 7 | Maid | P | P | N | M | M | N | P | P | N | R. | Hernia | Rest | Partially relieved | |
| J.D. 62 | Free Oper | P | P | P | P | M. | P | P | P | P | R. | Onset of abscess | Not treated | | Free abscess |
| M.D. 47 | Laborer | P | P | P | P | P | P | P | P | P | R. | Free abscess | Injection and drainage | Recovery; good result | Lifting stool |
| A.M. 37 | Cobbler | P | P | P | P | P | P | P | P | P | R. | Bursitis | Injection and drainage | Recovery good result | Hip strain |
| M.C. 50 | Free Oper | P | P | P | N | N | M | P | ? | ? | R. | Bursitis | Not treated | | Struck by automobile |
| G.S. 60 | Watchman | P | P | N | P | N | P | P | P | M | R. | Bursitis | Rest | Relieved | Osteo-arthritis |
| H.G. 34 | None | P | P | N. | P | N | P | P | P | P | R. | Bursitis | Rest | Improved | Spondylitis thoracica |
| M.W. 63 | Housewife | P | P | M | M | N | M | P | P | M | R. | Bursitis | Rest | Relieved | Osteo-arthritis |
| K.P. 30 | Housewife | P | P | N | N | M | M | P | ? | P | R. | Bursitis | Rest | Relieved | Unknown |
| D.P. 48 | Minister | P | P | N | M | M | P | P | P | P | L. | Bursitis | Rest | Relieved | Strained leg |
| M.L. 41 | Laborer | P | ? | N | M | M | P | P | P | P | L. | Bursitis | Rest—heat | Cleared up | Scrub of leg |
| S.C. 50 | Student | P | P | N | M | N | P | P | P | P | R. | Bursitis | Rest—heat | Cleared up | Kicking football |
| M.D. 60 | Housewife | P | P | N | M. | M. | P | P | P | P | L. | Bursitis | Rest—heat | Relieved | Osteo-arthritis |
| J.L. 4 | Student | P | ? | M. | N | N | P | P | P | P | R. | Free abscess | Traction | Relieved | Hip strain from sport |
| J.S. 0 | Student | P | P | M | M | N | P | P | P | P | L. | Toe, hip | Artificial | Bad | Strike of hip getting off horse |
| R.T. 34 | Track Helper | P | P | N | M | M | P | P | P | P | R. | Dislocation of hip | Rest | Improved | Lifting heavy box |
| B.W. 3 | Brass Caster | P | P | M | M | N | P | P | P | P | L. | Loose articulation | Rest | Cured | Diving |
| M.K. 9 | Clerk | P | P | M. | N | N | P | P | P | P | L. | Dislocation of hip | Rest | Improved | Lifting box |
| A.C.B. 9 | Student | P | P | M | M. | M | P | P | P | P | L. | Dislocation of hip | Rest | Improved | Springing from couch |
| W.F. 70 | Laborer | P | P | P | P | P | P | P | P | P | L. | Infectious deep abscess | Injection and drainage | Cured | Old untreated fracture of neck of femur |

SUMMARY OF CASES—Continued

| Name Age | Occupation | Symptoms | | | Signs | | | | Pain on | | Side affected | Tentative diagnosis | Treatment | Result | Ascribed cause |
|-------------|------------|----------|----------|----------|-------|-------------|------------|------------|---------------|----------------|---------------|---|--------------------------|----------|-----------------|
| | | Felis | Weakness | Swelling | Tumor | Fluctuation | Limitation | Tenderness | Active motion | Passive motion | | | | | |
| H.M. 81 | None | P | P | P | P | P | P | P | P | P | R. | Infectious iliopectineal bursitis | Incision and drainage | Died | None |
| P.R. 2 | None | P | P | P | P | P | P | P | P | P | L. | Thc. hip | Incision and drainage | Relieved | None |
| G.P.W. 9 | Student | P | P | N | N | N | P | P | P | P | L. | Iliopectineal bursitis | Rest | Improved | Football |
| E.U. 20 | Student | P | P | N | N | N | P | P | P | P | R. | Iliopectineal bursitis | Rest | Improved | Football |
| W.E.S. 6 | Student | P | P | N | N | N | P | P | P | P | R. | Iliopectineal bursitis | Rest | Improved | Rowing |
| L.G. 44 | Laborer | P | P | N | N | N | P | P | P | P | L. | Iliopectineal bursitis | Rest | Improved | Unknown |
| L.E. 18 | None | P | P | P | P | N | P | P | P | P | L. | Iliopectineal bursitis | Rest | Improved | Osteo-arthritis |

P Positive. N Negative.

point on the anterior aspect of the hip at which the bursa is nearest the surface. The thin point in the joint capsule lies directly through the bursa. If no communication existed between the bursa and the hip joint, infection in the bursa would most certainly be carried into the hip joint by the aspirating needle. Then again, with no communication between the bursa and the joint, if the existence of this bursa were not recognized and pus obtained from aspiration of the bursa, an operation on the hip joint would most likely result in the infection of the hip joint with all the tragic results of such an infection. The following case from the author's series will illustrate this surgical tragedy very vividly.

A girl of eighteen years, a student in a school of physical education, "strained" her right hip in straddling a "buck." She was conscious of some discomfort in the hip but did not regard it as of any importance. Shortly afterward, she contracted a severe epidemic "cold" which, after a few days, seemed to have settled in the "strained" hip. The pain in the hip became very much worse, the hip could not be extended because of pain, the patient's temperature arose to 104 degrees F., and all the signs of a severe toxemia were present. The physicians in attendance were unable to find anything except the hip condition to account for the severe toxemia and a surgeon was called in consultation. The surgeon, while not fully satisfied with his findings, because of the difficulties of examining a very ill patient, concluded that the hip joint was the site of a purulent infection and opened the hip joint through an Ober incision on the posterior aspect of the joint. To his surprise, the hip joint showed no evidence of infection except for a small amount of fibrin. The patient was returned to

bed and traction was applied to the affected leg. On recovering from the anesthetic, the patient complained bitterly of pain and more weight was added to the traction in the belief that the amount of weight was insufficient. The pain, however, became greater with the increasing weight, a rather unusual situation in hip joint disease. The temperature and other signs of severe toxemia, present before operation, persisted unabated. Several days later the patient was again operated upon the incision being made in the front of the hip region. When the soft tissues, corresponding to the site of the iliopectineal bursa, were cut into a large amount of bright yellow pus was released. Still not realizing the true location of the lesion the surgeon continued his incision into the hip joint to get through and through drainage. The pain and other symptoms gradually receded. The patient ultimately recovered with an ankylized hip.

From the clinical course of this case, it is evident that the lesion causing the toxic symptoms was an acute purulent iliopectineal bursitis. Had the surgeon made a correct diagnosis, the patient probably would not have an ankylized hip and ruined career today.

SEX

A series of 33 cases which have been seen by the author are presented here and analyzed. In this series 11 or one-third of the subjects were female and two-thirds of them were male. The preponderance of males is not surprising the real surprise being the high percentage of females affected, since violent muscular activity is a prominent factor in the etiology of the condition in most cases. This high percentage of females who have been affected might be explained by the tendency on the part of the women of today

to recognize no activity from which they are barred because of their sex.

AGE

The series is classified according to the decade of age in which the cases fall

| | Cases | Total | Per cent |
|----------|-------|-------|----------|
| 1 to 10 | 1 | 10 | 33 1/3 |
| 1 to 20 | 10 | | |
| 21 to 30 | 8 | 11 | 33 1/3 |
| 31 to 40 | 3 | | |
| 41 to 50 | 4 | | |
| 51 to 60 | 5 | 11 | 33 1/3 |
| 61 to 70 | 4 | | |
| 71 to 80 | 2 | | |

Several interesting facts may be gleaned from the distribution of cases according to age. In the 1 case observed in the first decade of life, the patient was afflicted with anterior poliomyelitis with residual paralysis involving one of the lower extremities. A long leg brace, applied to the extremity to prevent deformity caused an irritation of the bursa by the force necessary to bring the extremity forward in walking. The second decade of life with 10 cases was twice as great as any other single decade. This frequency of involvement in youth is explained by the participation of young people in vigorous out-of-door sports.

During the age period of 21 to 50 the period of adult life of greatest activity in industry 21 cases or 33 1/3 per cent of the cases were observed.

During the age period from 51 to 80 the other third of the cases was observed and, while industrial activity would account for some cases, another factor hypertrophic changes about the hip joint, enters to be a causative factor.

So, it might be said that in youth, participation in sports is a prominent etiological factor. In early and middle adult life, occupational activities of a vigorous nature are a factor and, late in life bony hypertrophy about the hip joint is a factor.

OCCUPATION

While the causative factors in the production of iliopsoas bursitis were not in all cases connected with the patient's occupation, a sufficiently large number of them occurred in the course of the patient's employment and the occupation was obtained in all cases. The importance of iliopsoas bursitis as a compensable injury has not been recognized due to the unfamiliarity of the profession with this condition. At least, 4 of

the cases in this series were compensated on the basis of the correct diagnosis.

| Occupation | Cases |
|----------------|-------|
| Student | 8 |
| Laborer | 7 |
| Housewife | 4 |
| Press operator | 2 |
| Pressman | 1 |
| Cobbler | 2 |
| Molder | 1 |
| Brass caster | 1 |
| Truck helper | 1 |
| Watchman | 1 |
| Clerk | 1 |
| No occupation | 4 |
| | 11 |

ASCRIBED CAUSES

The sudden onset of symptoms and the violent nature of the trauma liable to cause the condition operated to make the probable cause of the condition fairly clear.

| Cause | Cases |
|-----------------------------------|-------|
| Violent hyperextension of hip | 3 |
| Lifting | 4 |
| Secondary to malarial convulsions | 1 |
| Occupational acts | 1 |
| Kicking football | 1 |
| Bowling | 1 |
| Rowing | 1 |
| Coasting | 1 |
| Automobile collision | 1 |
| Struck by automobile | 1 |
| Secondary to poker spine | 1 |
| Unknown | 3 |

In 10 cases the cause was sudden muscular action involving the psoas muscle while the thigh was flexed on the body or the body was flexed on the thigh. This is an important observation. If the anatomical peculiarities of the iliopsoas bursa be realized, the explanation is obvious. The bursa is in front of the hip joint and attached posteriorly to the anterior part of the joint capsule. In front of the bursa is the tendon of the psoas to which the bursa is also attached. When the thigh is flexed on the body or the body on the thigh, the psoas tendon tends to ride away from the front of the hip joint. In this position the bursa is stretched between the capsule of the hip joint and the tendon of the psoas. Sudden violent action on the psoas causes violent stretching of the bursa, a trauma which initiates the pathological changes in the bursa. Continued use of the traumatized bursa results in the changes in the bursa common to all bursae. Six cases were secondary to hip joint disease or spine disease which interfered with the normal function of the hip.

Type Five cases were infectious. In the infectious cases, trauma may still be a factor with infection elsewhere in the body complicating what might otherwise be a cystic type of lesion. Twenty-eight cases were cystic or non-infectious.

Results One person died from the septicemia which was associated with, but not secondary to, the bursitis. All the other cases recovered although those associated with malum coxae senilis and poker spine could be considered only temporary and recurrence should be expected.

One case in which the hip joint was opened in the presence of the infection in the bursa recovered with an ankylosis of the hip. Another patient, who was operated upon with a diagnosis of tuberculosis of the hip unconfirmed by roentgenological examination, recovered with an ankylosed hip. The subsequent examination of tissue removed at the time of operation showed no evidence of tuberculosis. The symptoms in the patient came on immediately after the patient had 'strained' the hip while dismounting from a horse and had existed only a few weeks when the operation was performed.

Four cases of the infectious type were treated by incision and drainage with ultimate recovery although drainage persisted for several months, a not unusual condition in any infected bursa.

Symptoms Pain was the outstanding symptom in every case. Pain is really of two types the pain of bursal irritation and the pain referred to the front of the knee and thigh from contiguous irritation of the femoral nerve. Weakness in the extremity affected was a positive complaint in all but four cases.

Swelling of the front of the hip region was complained of in 10 cases.

Signs Every patient on examination showed tenderness on pressure over the small area in front of the upper end of the thigh just below Poupert's ligament and about midway between the anterior superior spine of the ilium and the symphysis pubis. This area is lateral to the femoral artery and medial to the femoral nerve. In size it is not more than 2 centimeters in diameter. In the late stages of the condition this area is considerably larger. All but 2 patients had pain on active motion of the hip especially in those directions in which the bursa was pressed upon or pulled upon. Six patients did not show pain on passive motions of the hip. Limitation of motion of the hip in abduction, with internal rotation and hyperextension was present in all but 2 cases. Fluctuation was elicited in 6 cases, 5 of which were of the infectious type. Tumor or swelling was present in 10 cases. The right bursa



Fig 1 Schematic drawing from Whitman's *Orthopedic Surgery of the Psoas muscle origin and insertion, showing the muscle riding away from the hip joint in flexion of the hip.*

was affected in 18 cases. The tentative diagnosis was right in 25 of the 33 cases. Twenty four cases, treated by rest and heat, were relieved and no recurrences have been reported.

THE EARLY CONCEPTION OF THE CONDITION

The purpose of this paper is to bring to the attention of the medical profession iliopectineal bursitis in its early stages as a common condition. The relatively large number of cases seen by the author within a 4 year period all of which correspond rather closely in signs, symptoms, and clinical course most of which had been seen by many other surgeons who were unable to make any diagnosis and who failed to relieve the condition, many of whom were relieved by the measures predicated upon the diagnosis of bursitis, suggests at least that it represents a common condition. Some of the cases presented herewith were seen before the author was ever aware that the iliopectineal bursa existed and were classified as undiagnosed in his files. All have been considered carefully from a diagnostic standpoint and several cases have been omitted from this series because other conditions could not be ruled out or the findings, while suggestive were not conclusive enough to warrant the diagnosis of iliopectineal bursitis.

A typical case report of the iliopectineal bursitis is given here in order that one may understand the dynamic pathology of the condition.

J. D., a 65 year old female press operator was seen in consultation on November 12, 1936, for a complaint of pain in the right hip region of 3 years' duration. The patient had worked as a press operator for over 20 years and shortly before the onset of symptoms had been obliged to change from a press in which the motion of the right leg was a forward swing to one in which the foot lever was pushed downward. She ascribed her hip pain to the change in the operation of the press. The pain complained of radiated to the knee. The hip was "stiff" in the morning on arising but gradually became less stiff after some activity. The pain, however, was greatest at the end of the day after activity and was better on holidays when patient did not work. For a time the patient was able to continue her regular work but about a year previous to this examination she had to give up all work because of the pain.

The patient appeared to be in good general condition for a person of her years and social status. The general physical examination developed no noteworthy defects.

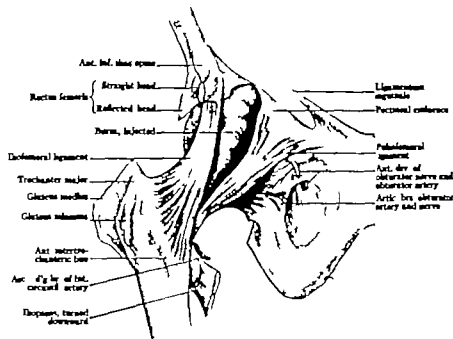


Fig. 2. The iliopectineal bursa injected to show its position and limits (from Hether's *Practical Anatomy*)

The right hip was held in about 5 degrees of flexion, and attempts to extend it caused exacerbation of pain. The patient held the hip in external rotation. Motion was possible in flexion 45 degrees, in abduction 30 degrees, in adduction 20 degrees, in external rotation 30 degrees and in internal rotation 0 degrees before pain came on. There was no shortening of the leg. The thigh circumference on the right was 25 inches less than the left, the calf circumferences were the same. The patient had tenderness on pressure over the front of the hip limited to the point where the iliopectineal bursa is superficial. The front of the right hip seemed definitely fuller than the left. The patient walked with obvious difficulty and with a decided limp.

The roentgenograms were negative except for slight proliferative changes at the margin of the acetabulum.

TYPICAL HISTORY AND EXAMINATION OF ILIOPECTINEAL BURSITIS

The chief complaint is pain in the hip region anteriorly radiating to the front of the knee. The onset is sudden following an injury wherein the psoas muscle is brought into action while the hip is in flexion. At onset the pain is not sufficient to cause alarm or to suggest a serious condition. The patient treats the condition as a strain of the hip and continues about his ordinary activities conscious of a soreness in the front of the hip region and at intervals getting a sharp twinge of pain in the front of the thigh which may radiate down to the front of the knee. The pain may be sufficiently annoying to cause the patient to give up work. The patient may notice an increasing

tendency to stub the toes of the affected leg, may notice a dragging or heaviness of that leg in walking, all of which probably indicate a weakness of the psoas on the affected side.

If a physician is consulted at that time by the patient, and then radiograms are taken, they will be found negative for hip joint disease, unless the patient be old enough to show proliferative bone changes about the joint margins. Whether the joint shows changes or not, the diagnosis is likely to be "rheumatism." Then will follow the inevitable search for a focus of infection with all the delay, costly diagnostic procedures, and still more costly, vain therapeutic procedures including everything which is known in physical therapy, internal medication, and even major surgical operations.

If the medical attendant perchance applies a well fitting plaster-of-paris spica and keeps it on for a sufficient length of time to permit the irritation in the bursa to subside the patient may get well, but under almost any other treatment the symptoms are likely to persist until the patient, exhausted in patience or pocketbook, or both, resigns himself to the lot of the crippled arthritic. If, in time, the bursa becomes enlarged sufficiently to produce a tumor in the front of the hip, surgical interference and an inquisitive attitude on the part of the surgeon will doubtless lead to the correct diagnosis.

SYMPTOMATOLOGY

The most common symptom complained of in iliopectineal bursitis is pain in the anterior aspect of the hip joint. The pain may be of an indefinite character described best as an aching pain or it may be a throbbing pain. If the pain radiates, as it frequently does, it radiates to the front of the knee. This radiating pain is a separate thing from the pain of bursal irritation; it is due to irritation of the anterior crural nerve in its course which overlies the bursa in front of the hip. This radiating pain is of frequent occurrence in iliopectineal bursitis. The pain in front of the hip is aggravated by activity.

Dragging of the leg on the affected side, stumbling limp and the weakness of the leg all mean the same thing but represent different expressions of the same phenomenon. Any one of this group of symptoms will be present as soon as atrophy of the psoas muscle takes place which is very soon after the onset. This weakness in the psoas expressing atrophy of the muscle is increasingly evident if general or local factors, giving rise to muscle fatigue, such as excessive use of the affected extremity, general body fatigue, or toxicity of the body, are present. Edema of the affected extremity is a symptom of infrequent occurrence and occurs only when enlargement of the bursa is sufficiently great and its relationship to the great saphenous vein such as to cause compression of the venous trunk.

Localized swelling in front of the hip, or tumor formation, occurs only when the bursa has increased greatly in size commonly in the most advanced stages. The presence of a well defined tumor is indicative of an old and advanced bursitis or an active infectious bursitis.

Flexion deformity of the hip may be present to a very slight degree, even in a relatively early case but marked deformity of this character is commonly associated with marked enlargement of the bursa or an acute infectious bursitis.

Limitation of extension or hyperextension of the hip is but the corollary of flexion deformity and has the same significance.

SIGNS

On inspection of the surface about the hip region nothing abnormal is apparent in the early cases. When however the bursa is acutely irritated or when it is distended but not necessarily enlarged a flexion deformity of the hip will be present. This may be marked enough to be evident on inspection or if it is very slight, the deformity can be detected only as a limitation of hyperextension.

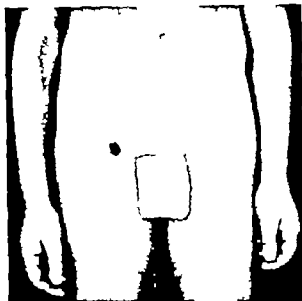


Fig. 3. Black spot marks the area of tenderness elicited in early iliopectineal bursitis.

In the late stages of the iliopectineal bursitis a tumor mass may be present in the front of the upper end of the affected thigh. In all the cases reported in the literature up to the present time, the tumor was the complaint, the treatment of which led to the diagnosis of bursitis.

Palpation of the anterior aspect of the front of the upper thigh may reveal a slight fulness in that area called Scarpa's triangle. The actual determination of fulness is so much a matter of individual skill in observation and its differentiation from lymph gland enlargement is so difficult that this sign is of small importance prior to the stage in which the tumor becomes well defined.

Probably the most consistent and the most definite finding leading to a diagnosis of iliopectineal bursitis is a point of tenderness, the area of which is not over 2 centimeters in diameter and is always located at a point over the front of the upper thigh or inguinal region. This point is just below Poupart's ligament half way between its attachments to the anterior superior spine and the pubis. It is about 2 centimeters lateral to the femoral pulsation. Without this finding a diagnosis of iliopectineal bursitis is not justified. This finding alone without confirmatory signs does not justify a diagnosis. However if definite tenderness on pressure is elicited at the point described the basis of a diagnosis has been made.

Active hyperextension of the body on the hips and active hyperextension of the affected hip on the body will cause pain in front of the hip, if the iliopectineal bursa is irritated. Active acute flexion of the hip from the sitting position with the knee extended gives a sensation of pain in front of



Fig. 4. Bursa in relation to the important nerves and blood vessels on the front of the thigh (after Lund). A, iliopectineal bursa which has been opened and broken, the center line indicating the extent of the bursa itself. B, anterior crural nerve. C, iliopectineal bursa. D, femoral vein. E, femoral artery. F, sartorius muscle.

the hip and the maneuver is weak in its performance because of the attendant weakness of the psoas muscle.

Passive hyperextension of the hip on the affected side causes pain in front of the hip region due to the compression of the irritated bursa between the hip joint and the psoas tendon. Where actual flexion deformity of the hip exists any attempt to extend the thigh at the hip will set up a protective muscle spasm and will be very painful. Extreme passive abduction of the thigh at the hip causes pain at the site of the bursa. Internal rotation of the affected thigh also causes pain. Deformity at the hip may vary from a limitation of hyperextension to a marked flexion, adduction and external rotation of the hip, the position of greatest relaxation of the psoas muscle.

Generalized edema of the affected extremity has been noted but is inconstant in its appearance and is usually present only late in the course of the disease after the more characteristic signs of the condition may be noted. Edema was noted in only one case in this series.

DIFFERENTIAL DIAGNOSIS

Hip joint disease is easily the most common and the most important condition from which iliopectineal bursitis must be differentiated. If the bursa communicates with the joint, the diseased process, whatever its etiology would unquestionably involve both the joint and the bursa, in which event the existence of the bursitis would be submerged in the more important joint disease. Even so, the bursal lesion might have practical importance as, for instance, in tuberculosis. While it is not necessary to invoke the presence of a communicating bursa with the hip joint to explain the tendency to persistent flexion deformity in tuberculosis of the hip joint, such a situation undoubtedly would increase the tendency to such a condition. The presence of a communicating bursa too would explain the tendency for cold abscesses to present on the anterior aspect of the hip.

An actively diseased hip joint is protected from motion in any direction by muscle spasm. In bursitis, active or passive motion of the joint is possible except in those directions wherein the bursa is pressed upon or distracted. In bursitis, depending upon the stage of the process, flexion deformity ranged from absence of hyperextension to 90 degrees of flexion. Further passive flexion may be possible, however, in bursitis, while in hip joint disease muscle spasm prevents motion in any direction. In bursitis, internal rotation and extreme abduction are provocative of pain. In hip joint disease the hip tends to assume a position midway between extremes and manifests objection to any motion by muscle spasm.

Tuberculosis of the spine with a psoas abscess must be considered in the differential diagnosis, but tuberculosis of the spine at a stage in which a psoas abscess is present would most certainly be sufficiently advanced to give positive finding roentgenologically and would also give the characteristic clinical findings of such a condition.

Perinephritic abscess or a collection of pus from the retroperitoneal region, finding its way along the course under the psoas muscle would present the condition most easily to be confused with iliopectineal bursitis. The signs of infection of marked proportions would most certainly distinguish the condition from non-infectious bursitis.

itis but might require incision and exploration to distinguish it from an infectious bursitis.

It is quite probable that many slight or early cases of non-infectious iliopectineal bursitis cases have been operated upon with a diagnosis of inguinal or femoral hernia the diagnosis being a negative one rather than one based on positive findings. Any surgeon engaged in the examination or treatment of hernia should be familiar with the signs and symptoms of iliopectineal bursitis as well as the mechanism of its production. Such familiarity would most certainly prevent many needless operations for hernia.

PATHOLOGY

While the exact histological structure of the bursa is still the subject of contention, it may be said that the bursa are of mesodermal layer origin and are analogous to the joint synovial membrane and the serous membranes. The reaction of the bursal membrane to mechanical or infectious irritation is essentially that of synovial membrane. There is first an increase in the fluid contents of the bursa or an effusion which in the non-infectious type, subsides if the bursa is put at rest for a sufficient period of time. If treatment is not instituted or imperfectly carried out, the bursa wall gradually becomes thickened to many times its normal thickness. Degenerative changes may occur in the membrane such as the formation of cartilaginous plaques and large cartilaginous bodies may even develop free in the bursa. In the infectious type of bursitis, the effusion goes on to the formation of pus which requires drainage or if undrained and not virulent goes on to the formation of a chronic abscess cavity lined with granulation tissue.

TREATMENT

There are certain definite principles of surgical treatment which if applied to affections of the bursa, will result in the alleviation, if not the complete cure of those affections. If it be realized that the bursa are the 'bearings' of the body, that they are located wherever motion with the minimum of friction is desired, if it be also realized that the structure of the bursa is analogous to the lining of the various closed cavities of the body such as the pleura, the peritoneum and the synovial membrane of the joints, that the first reaction of the bursal membrane is like in other cavities, an effusion, followed by a thickening of the membrane to many times its normal thickness if not promptly treated by rest, it will be evident that physiological rest for the affected bursa is the essential principle of treatment. Without rest,

other measures are worthless. With rest, heat may be employed to aid in the restoration of the membrane to normal thickness, and the absorption of the fluid. The length of time necessary to restore the bursa to normal varies with the efficiency with which treatment is carried out, but at best consumes many weeks in chronic cases, and is slow even in acute cases. Failure to obtain complete results quickly should not necessitate a resort to focal infection to explain the failure but should cause the medical attendant to evaluate the skillfulness of his treatment. Even under the most skillful treatment, patience on the part of the physician and the patient is necessary. Repeated aspiration in addition to rest is recommended. If aspiration is attempted, the operator should bear in mind the proximity of the bursa to the femoral artery and the saphenous vein. The pulsation of the femoral artery can be readily obtained and the operator should keep at least 1 centimeter lateral to this point.

Incision and drainage of the bursa in non-infectious bursitis is on a par with the same procedure in a joint in a like condition. It is mentioned here but to condemn it. If any surgical procedure is considered desirable because of failure of conservative treatment or in order to shorten the period of convalescence, the bursa should be excised as a whole. In infectious bursitis, the surgical principles governing infections obtain. Pus in a bursa must be released by incision and by the maintenance of adequate drainage.

PROGNOSIS

In the early stages of non-infectious bursitis full recovery should occur if the affected bursa is put at rest. Heretofore the failure to diagnose the condition has made early treatment impossible. Even with early diagnosis the surgical significance of the bursa, the unwillingness or inability of the patient to give the necessary attention to rest, or the failure of the medical attendant to understand the necessity of rest will probably terminate in unsatisfactory results.

When the condition has existed for some months, the amount of rest which would be required to clear up the affection is prohibitive. Excision of the bursa may be considered, but its inaccessibility and its proximity to the important femoral artery, saphenous vein, and femoral nerve call for the most careful dissection and inject danger into the case, which should be carefully weighed in each case. Aspiration of the bursa with rest has given good results in some cases and should be tried faithfully before resorting to excision.

In infectious bursitis, the prognosis is directly proportional to the virulence of the infection and to the lack of resistance of the patient. Recovery with good function takes place if surgical measures are not too long delayed.

SUMMARY AND CONCLUSIONS

Iliopectineal bursitis is not uncommon but is not commonly recognized

Failure of recognition results in mistaken diagnosis followed by serious surgical measures and at times by serious disability

The symptoms and signs of the condition are clear and permit a clear cut differential diagnosis.

The treatment of the condition is the treatment of any bursitis and the results of treatment are commensurate with the appreciation of the underlying etiological factors and the surgeon's understanding of the pathology of the bursa

The location of tenderness in iliopectineal bursitis is so definite that its elicitation may be said to constitute the basis of a diagnosis.

The frequency of communication between the bursa and the hip joint obligates the orthopedist to consider this bursa in all considerations of hip-joint complaints.

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FRACTURE OF THE NECK OF THE FEMUR

A SIGHT FOR ACCURATELY DIRECTING THE DOWEL PEG

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SURGEONS the world over complain of inability to direct the bone-peg accurately in repairing a fractured femoral neck. Some are naturally so gifted that they can usually drill the hole for the peg or can hammer the nail blindly, straight through the narrow (2.8 centimeters) neck of the femur and into the center of the head, but there are instances aplenty when the peg or nail missed the central course and was demonstrated by X-ray to be even outside the neck or head resulting in intense anguish to all concerned.

Shapes of femurs like faces are remarkably variant as is apparent when reviewing a large series. Also the aim of the surgeon, guided by measurements and angles through this intricate target shielded as it is from vision is subject to much error. There are always more shots around the target than in the bull's-eye. If however the two sights of a gun are properly aligned the bull's-eye is hit.

THE PRINCIPLE

The following method is offered in which the peg is directed automatically and accurately exactly where desired. The instrument has a front and rear notch or sight 3 inches apart into which the drill is laid and so directed. The rear sight is on a slider and as the drill penetrates the bone the rear sight follows along always keeping the drill accurately in its course.

The sights are automatically aimed by contacting the apparatus by direct vision with the shaft and neck of the femur through the two usual lateral and anterior incisions.

The apparatus has two arms each terminated by a tiny metal spike. That on the shaft arm is thrust into the femoral shaft just below the greater trochanter and that on the neck arm is driven up to its shoulder into the center of the femoral neck just proximal to the fracture (Fig. 3). This aims the apparatus and now a drill guided by the sight is certain to penetrate through the exact center of the femoral neck.

The center of the drill guided by the two sights is bound to pass directly in line with the neck arm of the apparatus and just 14 millimeters from the shoulder of the spike. As this shoulder is in contact with the center of the anterior surface of the neck the drill will pass through the center of the

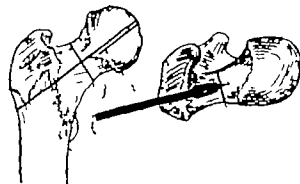
neck which has an average thickness of 28 millimeters (Fig. 6)

MEASUREMENTS OF FEMURS

To ascertain the average size and the variation from it, the following measurements were taken from fifty femurs (1) vertical depth of neck at its middle and at a right angle to the neck (2) width of neck anteroposteriorly at its middle and at a right angle to it, (3) maximum distance in direction of peg, (4) length of head measured from its anterior lip (5) length of femur from the bottom of the internal condyle to the top of the greater trochanter

| Depth of neck—cm. | Width of neck—cm. | Length in direction of peg—cm. | Length of head—cm. | Length of femur—cm. |
|-------------------|-------------------|--------------------------------|--------------------|---------------------|
| Average 2.6 | 3 | 1 | 3.5 | 47 |
| Maximum 4.7 | 3.3 | 1 | 4.0 | 49 |
| Minimum 2.0 | 1 | 0 | 1.8 | 39 |
| Variant 1.7 | 2 | 3 | 2 | 11.1 |

The neck widens slightly toward the head and the head is in the direct line of the neck. The greatest width of the neck near the head is between the upper and middle thirds and near the trochanter between the lower and middle thirds. The neck tapers anteroposteriorly and widens vertically as it approaches the trochanter and



| | | | | |
|---------|------|-----|-----|-----|
| Maximum | 11.1 | 4.7 | 4.0 | 3.3 |
| Minimum | 8.0 | 3.0 | 2.8 | 2.5 |
| Average | 10.0 | 3.6 | 3.5 | 2.8 |
| Variant | 5.0 | 1.7 | 2.2 | 0.8 |

Fig. 1. Measurements (in centimeters) determined from 50 femurs.

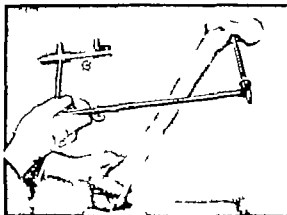


Fig. 3. To apply the sight to the femur the spike of the neck arm, *B*, through the anterior incision is driven into the femoral neck. Then by adjusting the length of the sliding arm, *B*, the shaft arm, *C*, of the sight can be made to enter the lateral incision and contact with the femoral shaft.

joins the trochanter in an oblique plane from forward and above running backward and downward.

DIRECTIONS FOR USE

The sight as pictured in Figures 3 to 7 is strong, ly made of tool steel and is an instrument of precision. It is applicable for use with the Albee motor driven bone mill or any other standard make. The Albee technique of the operation is followed the merits and success of which I can personally vouch for as Dr. Albee performed his operation on my own hip.

Through the vertical incision just internal to the anterior superior spine of the pelvis and between the rectus and iliacus muscles the fractured femoral neck is exposed. The bone ends are freshened and accurately fitted together the

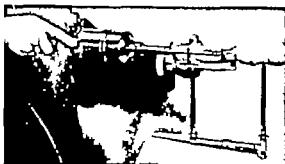


Fig. 4. Aiming of sight as seen from above. Both arms of sight are pegged to the femur, so the drill will enter the center of the flat surface 13 millimeters below the ridge of origin of vastus externus and will pass through the femoral neck just half the width of the neck away from the terminal shoulder of the neck arm.

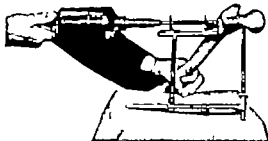


Fig. 5. The sight is aimed by driving the two small terminal spikes into the neck and shaft of the femur. The drill now laid in the two notches or sights will be accurately directed.

patient's legs being held securely with traction on the orthopedic table.

Through a vertical lateral incision the shaft of the femur is exposed below the upper attachment of the vastus externus. The bone peg should enter the center of the flat area 13 millimeters below the ridge of origin of the vastus externus (Fig. 4) and should run exactly through the thickest part of the neck and into the head so that it terminates where the head is longest and above the ligamentum teres. It should avoid the vicinity of the ligamentum teres so that this important blood supply to the head will not be damaged (Fig. 7). In order to guide the peg exactly right the spike of the neck arm of the sight should be driven into the femoral neck slightly above the center of the anterior surface of the neck. This slightly upward direction of the peg is better also for strength as it is more in line with weight bearing.

The length of the neck arm of the apparatus is so adjusted by the set nut beforehand that the point of the drill when the drill is guided by the two notches or sights, will pass the end of the neck arm just 14 millimeters from the shoulder of its terminal spike (Figs. 5 and 6). Femoral necks range in thickness from 2.5 to 3.3 centimeters, thus having a variant of 8 millimeters of thickness or a 4 millimeter variant to the center of the neck. The length of the neck arm is readily adjustable for this, if for the sake of accuracy it is desired. The fixed measurement of 14 millimeters, however, will be satisfactory for any width of head.

The $\frac{3}{4}$ inch spike on the end of the neck arm of the apparatus is hammered to its shoulder into the neck of the femur slightly above the center of its anterior surface and just proximal to the fracture line (Figs. 3, 4, and 6). At this stage the bone ends should be held together. By loosening the set screw the sleeve of the apparatus can be drawn out so that the shaft arm can be made to

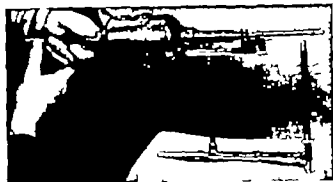


Fig. 5 As the drill penetrates the bone the sliding rear sight follows along always keeping the drill accurately in its course. As soon as the drill point is engaged in the bone the rear sight alone does the guiding. The length of the neck arm of the apparatus is so adjusted by the set nut beforehand for the average size of femur that the point of the drill, when the drill is guided by the two notches or sights, will pass the end of the neck arm just 14 millimeters from the shoulder of its terminal spike.

enter the lateral incision (Fig. 2). The spike on the shaft arm is hammered into the shaft of the femur so that the drill when laid in the two notches 3 inches apart will touch the femur with its point at the center of the bare flat area and 13 millimeters below the ridge of origin of the vastus externus (Figs. 3 and 4). The set screw is tightened and the sight is held in place firmly by an assistant.

The fracture line is then allowed to gap a little so that the assistant can announce when the drill which is now driven through the bone reaches that far. The fractured ends are then again put in place and the drill is continued on into the femoral head to the depth desired as read on the scale on the shaft of the drill. Usually the length of the head is equal to the vertical depth of the femoral neck at its center though there is a maximum variant in this measurement of 14 millimeters. The exact proportion between the length of the distal and proximal bone fragments can be seen in the X ray films and so the penetration by the drill beyond the fracture can be calculated. Due to absorption in the neck the length of the peg required is usually 7 or 8 centimeters instead of 10 centimeters or average maximum distance measured in intact femurs.

The machine made autogenous dowel peg is passed into the drill hole by gentle taps of the hammer and the bone fragments are jammed together by pounding on a mallet with its handle against the femur.

AN ADDITIONAL TECHNIQUE

Here a refinement of technique may be added because by using the sight, the position of the peg



Fig. 6 A quadrant has been cut from the femoral neck to expose the drill passing accurately through the center of the neck. It cannot fall in its aim as the center of the drill must pass the end of the neck arm at an exact distance from the shoulder of the latter, which is contacted with the anterior surface of the femoral neck.

in the femoral neck is accurately known. There is a tendency for the femur to fall away from its head, especially if the peg is at all loose. A cardinal principle in bone grafting is to fit the parts accurately together and to hold them firmly and without the least motion. With the Albee

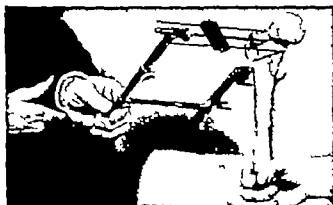


Fig. 7 Use of sight without exposing the femoral neck. Method of accurately placing the neck arm of the sight on the femoral neck without making the anterior incision. The lateral incision alone is used to expose the shaft. The neck arm has by removing its shoulder bearing sheath been converted to the thickness of a Steinmann pin. By sense of touch two pointed knitting needles thrust through the skin are made to mark the upper and lower borders of the femoral neck. They are then by set-screws clamped firmly in a block, through which is a channel to guide accurately the Steinmann pin or neck arm, to prick into the anterior surface of the femoral neck at the point desired.

mill it is easy to fashion two round autogenous bone pegs, each the size of a match, and pass them through drill holes at a right angle to the neck to run the peg in place in both the distal and proximal fragments. If the drill holes are threaded by a thread tap the unthreaded pegs hammered into these holes will hold firmly.

USE OF SIGHT WITHOUT EXPOSING THE FEMORAL NECK

There will always be a percentage of failures to obtain union by the Whitman or any other closed method of setting intracapsular fractures of the femoral neck, because so often torn capsule and soft parts are found between the fragments. This applies even if a peg or nail is used unless the fracture line is openly inspected and the soft parts are removed from between the bone ends. Therefore at least in operations for non-union, the anterior incision exposing the femoral neck is advised. For those desiring to insert a nail, beef bone or other dowel through the femoral neck and to use only the lateral incision as in a primary operation, the use of the sight is still available as the neck arm is at once made slender and shoulderless at the point by sliding off from it a tubular sheath which was there for strength and to provide the terminal shoulder (Fig. 7). This narrow neck arm like a Steinmann pin may be thrust through the anterior surface of the thigh to prick into the center of the femoral neck. The center of the neck may be determined by guidance under the fluoroscope when verifying the set of the fracture or more simply by the following method.

After the fracture is set and the position verified by X-ray a 9 inch slender pointed rod or a knitting needle is thrust to the femoral neck and by feeling the way is passed just over the upper border of the neck and left there as a guide. Similarly another needle is thrust through the skin $1\frac{1}{2}$ inches below it and by sense of touch is thrust just past the lower border of the neck. A metal block with two small holes $1\frac{1}{2}$ inches apart is then passed over the two projecting ends of the needles and is by two set screws clamped solidly with the needles in the holes (Fig. 7). Through the center of the clamp is a channel which is made so that it points to just above the center of the neck of the femur. This is easily possible because one guide needle marks the upper and the other the lower border of the femoral neck. Through this channel or bore as a guide the slender neck arm of the sight is passed and thrust through the skin to the center of the femoral neck and with a light tap is fixed there. Thus when advisable the sight will accurately guide the drill or nail without the necessity of exposing the neck of the femur.

A few trials on the cadaver will readily verify the accuracy and ease of this method.

If a nail flanged or otherwise is used it can be directed by the sight. A special nail set is attached firmly to the head of the nail to receive the blows of the hammer and is laid in the notches of the sight just as is the drill when preparing a hole for the dowel peg. For this use the spike screwed on the end of the shaft arm is changed for a longer one so that the front sight will clear the nail.

VARICOGRAPHY¹

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THE use of contrast media to visualize roentgenographically inaccessible cavities or hollow organs is now a commonplace procedure. The value of these drugs originally depended on their radiopacity, but as research in this field developed, agents were produced which possessed in addition therapeutic qualities. These media were first introduced by injection or instillation in order to visualize local parts, but the science developed rapidly, so that today, many chemicals are introduced intravenously in order to render distant organs opaque. In many instances these drugs, in addition, permit studies of the secretory or excretory capacities of the tracts so visualized. Few organs today remain inaccessible to roentgenographic demonstration.

The injection of opaque material to visualize vascular channels has heretofore been restricted to specimens removed at autopsy operation, or in animal experimentation. Its employment *in vivo* however is of more recent origin and has been made possible by the development of opaque solutions which can be introduced directly into the circulation without deleterious effect. In this study the venous channels of the lower extremity were injected with skiodan. Our objects were (1) to visualize the morphological changes that occur in varicose veins, (2) to determine the character of the associated circulatory phenomena, and (3) to discover if possible the presence or absence of vascular pools or venous channels subjacent to varicose ulcers.

ANATOMY OF NORMAL AND PATHOLOGICAL VEINS

A brief review of the normal and morbid anatomy of the veins of the lower extremity will facilitate greatly an understanding of our objectives. The venous channels of the lower extremity consist of two sections the superficial and deep. The former is composed of two trunks the long and short saphenous veins. The long saphenous vein is placed at the antero-internal aspect of the leg and is formed by the confluence of the veins on the internal aspect of the foot and ankle. Beginning slightly above the internal malleolus, it is directed upward internal to the tibia and posterior and internal to the internal condyle of the femur. As it continues upward it inclines forward and outward to reach Scarpa's triangle, where it terminates in the femoral vein. The short saphenous vein is

formed over the posterior and external aspect of the foot. It passes at first below the external malleolus and then ascends behind the external malleolus along the outer border of the Achilles tendon to the middle of the calf above which it is continued in the superficial fascia to the popliteal space to terminate in the popliteal vein. The deep veins of the lower extremity are situated in and collect blood from the deep tissues of the foot and ankle and in the popliteal space they form the popliteal vein which is continued upward into Hunter's canal to become the femoral vein. These venous systems form an extensive anastomosis over the leg and thigh. Communication between veins is by the *venae comites* whose number and relation vary greatly (1, 4).

Normal veins pursue a straight course without kinks or tortuosities. The veins differ from arteries in that they are provided with valves whose free borders are directed toward the heart. In the smaller veins these valves are single but in the larger veins they may be double or even triple. The integrity of this valvular mechanism in great measure determines the competency of the venous system, as will be seen later.

Varicose or dilated veins assume various bizarre shapes. Masses of these clumped veins protrude under the skin as nodular or saccular unsightly masses. The walls of the afflicted vein become extremely thin and at times even calcified, so that they may be demonstrated on flat plates of the extremity. As a result of vascular stasis, phlebitis and thrombosis are common. Deficient aeration and edema of the soft parts favor the formation of ulcers on the slightest trauma and these ulcers are prone to become extremely indolent and difficult to cure. Involvement of the subcutaneous veins frequently results in thickening of the skin with the formation of eczematous patches.

Under normal conditions, blood takes the shortest route to the heart and the direction of the flow in the veins of the lower extremity is in the main upward. Circulation from the superficial to the deep vessels, via the communicating veins is possible reversal of the flow occurs in disease. Normal circulation is the product of the pump-like action of the muscles associated with the aspiratory effect of the pelvic vessels and the changing intra abdominal pressure produced in respiration. In order to maintain normal direction and

pressure, the efficiency of this tubular system must be maintained.

In disease, however, some portion of the system becomes damaged and as a result definite changes occur in the direction of the flow. Since the deeper system is protected by surrounding muscles and a more liberal valvular mechanism, it consequently remains relatively normal but the superficial system being unsupported and possessing fewer valves, undergoes distinct changes and the normal hydrostatic pressure in the system is destroyed. The severity of this disturbance will in a great measure depend upon the degree of incompetency of the valves which nature has erected as dams along these channels. Under these circumstances, the circulation becomes slowed up and even reversed. This effect can readily be demonstrated on intravenous injection of opaque solutions during fluoroscopy. Clinically, however, the Trendelenburg test permits us to observe this phenomenon and a brief description of it will be of interest to our readers.

In the recumbent position, after the veins of the lower extremity have been emptied by elevation a tourniquet is applied at the mid-thigh and the patient permitted to stand. Where varicose veins exist, it will be noted that there is distention of the veins above the tourniquet whereas the veins below remain collapsed. If the tourniquet is removed the veins below fill rapidly. This is called the Trendelenburg positive and is due to incompetency of the valves of the superficial saphenous system.

The rapid downward descent of the column of blood in the veins from the saphenofemoral opening often imparts a distinct thrill to the palpating fingers. When the tourniquet is tightly applied with the patient in the upright position, if the veins fill rapidly from below we have the Trendelenburg negative. This is due to valvular deficiency in the communicating system. If on application of the tourniquet the veins fill rapidly from below and are still further distended on removal of the tourniquet, we then have the Trendelenburg double. This phenomenon is due to incompetency of the communicating veins as well as back flow through the great saphenous vein. To prove these observations, McPheeters (3) injected lipiodol into two living subjects and observed the venous flow during fluoroscopy. The objection to lipiodol is that its specific gravity is greater than blood and it may of itself gravitate to peripheral parts and thus simulate reverse flow. However, he (4) subsequently repeated his experiments utilizing skiodan the medium which we have employed for contrast purposes.

TECHNIQUE

Any syringe and needle used in the injection treatment of varicose veins may be employed and from 5 to 20 cubic centimeters of a 40 per cent skiodan solution is sufficient for the study. Patient prepared as for intravenous medication. The use of the tourniquet is optional as venous dilatation is so great that satisfactory plates may be taken without its use. To test the mechanics of the Trendelenburg test, the tourniquet must be employed. The patient is placed upon or in front of the fluoroscope and the needle inserted into the vein. When we are assured that the needle is within the vessel, the material is injected slowly and without undue pressure during fluoroscopy and the veins studied under varying conditions of pressure and posture.

For record purposes, stereoscopic plates are taken. The limb is placed upon a plate changing device and the vein injected while the plates are being taken. The needle should not be removed between exposures since it serves as a guide to the site of injection and prevents back flow of the skiodan upon the skin, where its superimposed density often masks finer vascular changes. In severe cases, satisfactory plates may be taken with the patient in the horizontal position but to detect early changes, the vertical position is preferable. If an ulcer exists, any small metallic device may be employed to mark its site or a fine wire may be molded about its periphery to define its extent more clearly. At times it may be desirable to take plates in both the horizontal and upright positions. Because of venous stasis and the slow diffusion of the dye, this may be accomplished frequently without reinjecting the vein. If necessary, however, the procedure may be repeated for further study.

Veins in which a latent phlebitis exists, are usually tender on pressure and warmer than the surrounding tissues. In such instances, the quantity of injected material must be reduced or else the latent process may become active and extremely distressing.

ROENTGENOSCOPY AND ROENTGENOGRAPHY OF NORMAL VEINS

By the use of stereoscopic plates, the venous system may be studied to an astonishing degree and the extremely rich circulatory channels of the thigh and leg traced from their origin to their termination. One obtains at a glance a panorama of the extraordinary anastomosing plexus. Normal veins pursue a straight course, without kinks or tortuosities, but gentle curves and undulations are common. In the main, the caliber is fairly even

throughout, and the terminal filaments taper off gradually to inconspicuous tubes. Sudden constrictions may normally exist and probably represent local spasms due to irritation by the chemical or needle. These pass off quickly and the normal caliber of the vessel is re-established. A careful examination of the roentgenograms often reveals oblique channels within the walls produced by intramural vessels. Sudden variations in the density of a vein as seen on the flat plate may be accurately identified by stereoscopic films. They do not represent the valvular mechanism but the exit of small communicating veins the axes of which are perpendicular to that of the parent vessel or else they represent the superimposed shadows of vascular loops.

The valvular apparatus may be studied best in normal veins and those of the arm are particularly suited for this purpose. Plates may be taken with the extremity in either the horizontal or vertical position. The appearance of the segments at the site of the valves will vary depending on the phase of valvular excursion during which the plates are taken and on the relation of the angle of the tube to the plane of the valves. Stated otherwise, the appearance of the valves on the roentgenogram will depend upon whether the central ray passes parallel or perpendicular to the plane of closure of the valves. The best demonstration occurs when the plane of the valves and the central ray coincide.

The valves are usually situated distal to the point of entrance of the communicating vein. We have found that muscular individuals have a more liberal valvular mechanism men possess more valves than women and stout females more than those of the asthenic habitus.

The first impression of the valve area is that a portion of a vein has been invaginated into the segment above it. On close inspection of this area, however it will be noted that the picture is composed of several details. If the valve is partially open, two extremely fine lines may be noted converging toward the center of the vein. These are the leaflets. External to these leaflets symmetrical bulges are present in the vein wall representing the filled paravalvular sinuses. Within these sinuses, distinct concentration of the dye occurs and is due to the slightly retarded circulation at the periphery of the veins. In the center of the vein, there is slight dilution of the dye due to the relatively swifter current. If the valve is closed just as the plate is taken the symmetrical bulge in the vessel wall is still present but there is in addition an extremely fine transverse density produced by the dye as a result of a momentary



Fig 1 The valvular mechanism in the normal veins of the arm. Valve leaflets represented by two light lines which converge toward the lumen of the vein. Note symmetrical concentration of the dye in the lateral sinuses. Transverse densities represent valve areas, where the projection of exposure is perpendicular to the plane of closure of the valves. Note entrance of communicating veins proximal to valves.

delay in the venous flow. Occasionally the symmetrical bulge may be present and within it transverse or oblique densities are demonstrated. This picture is produced technically by the projection of the exposure in a direction perpendicular to the plane of the valves so that we are, so to speak, looking down the veins toward the valves (Fig 1 a, b c).

Venoscapy permits us to visualize the movement of the dye under various conditions. It will be observed as the mixture is introduced that it is rapidly taken up by the blood stream and swirled upward in the direction of the heart. Most of the chemical is carried by the main stream but some of it escapes into the lateral radicals and a smaller quantity into the deeper vessels. A slight but distinctly limited back flow occurs due probably to the force employed by the syringe method of introduction. However extensive reflux does not occur in normal veins as the downward migration of the fluid is quickly checked by the nearest valve.

If the vessel is injected while the patient is in the vertical position the mechanism of the flow as outlined above still obtains but the circulation appears to be retarded somewhat. The reflux of



Fig. 2.

Fig. 3.

Fig. 4.

Fig. 2. Bulbous enlargement in the popliteal region. Note the concentration of the dye in the distended lumen. The second exposure was made immediately after and shows retrograde extension of the dye, although stasis persists in the loop.

Fig. 3. Venous pools and stasis with moderate concentration of the dye at the base of a varicose ulcer.

Fig. 4. Illustrating the extreme tortuosity of varicose veins. The veins were injected in the thigh and marked retrograde circulation is demonstrated.

the fluid from the site of injection does not appear to be greater than that which is noted when the patient is in the horizontal position; the returning stream is checked by functioning valves. Without instruments of precision we were unable to study the difference in the rate of flow in these two positions.

The application of pressure to the area of injection rapidly spreads the dye in all directions but mainly in the direction of the normal flow. Muscular movements are but another form of pressure and assist materially in emptying the vessels. The dilution of the dye is so quick and its passage so rapid that no effort was made to study the effect of respiration on normal venous circulation. This could be studied much more satisfactorily in pathological veins.

ROENTGENOSCOPY AND ROENTGENOGRAPHY OF ABNORMAL VEINS

Despite our knowledge of the subject and our appreciation of the pathology of varicose veins, the extent of the process as revealed by skiodan is truly astonishing. In our series, the dye revealed involvement of the vessels to a degree unsuspected by the physical examination.

Not only is there a dilatation of the affected vein, but there is in addition an apparent increase in its length. The vessels acquire bizarre shapes, the commonest of which is the formation of loops or coils which extend in all directions. The appearance of these loops will vary depend-

ing on the plane along which the dilated vein extends. On the anteroposterior plates circular dilatations may extend to the right or left of the axis of the vessel. On the lateral plates, one often sees bunches of dilated loops apparently suspended from the vessel in "grape-like" formation. Commonly these loops press upon each other producing a localized obstruction and the circulation in these areas is consequently delayed. Stasis results with concentration of the dye in the most dependent portion of the loop (Fig. 2). On the other hand, if the direction of the exposure is perpendicular to the plane of these vessels, nodular or "pearl-necklace-like" dilatations are seen. These appear to be more common in the most superficial vessels. "Wood" or "sky rocket" dilatations are common and these superficial varicosities often indicate fairly extensive disease in the more deeply situated vessels of the superficial venous system.

We are inclined to believe with Sgalitzer that the moth-eaten indentations which are noted in some of the vessels represent a localized inflammatory process in the wall or else thrombosis of the vessel.

Venous pools are common in the vicinity of ulcers and feeder veins which enter the base of ulcers may be easily demonstrated by a simple procedure. The site of the ulcer is marked and the vein injected with the patient in the horizontal position. Having completed the study of the vessels, the limb is elevated and the veins quickly



Fig. 5.

Fig. 6

Fig. 7

Fig. 5 Comparison of normal with pathological vein. Note dilatation of communicating venous system. Stereoscopic vision shows a vein completely encircled by a communicating vein (below circular density in mid-calf)

Fig. 6. The veins were injected in the popliteal region. Note retrograde circulation and concentration of the dye in the loop. "Pearl-necklace" type of varicose veins.

Fig. 7 An advanced case. Note dilatation of venous loops. Plates taken in horizontal position. There is no dilution of the dye despite the large volume of blood in the vein.

emptied. Even in the most extensive dilatation some residue of the dye will be observed at the base of the ulcer although the remainder of the vein has been completely emptied (Fig. 3)

Multiple kinks may be seen in localized segments of the vessel and result in deflection of the circulation. Sudden dilatation of the vessel wall proximal to the kink may indicate moderate obstruction at this level which appears to be further corroborated by the concentration of the dye and venous stasis (Fig. 4)

As a result of the marked phlebectasia secondary dilatation occurs in the veins of the communicating system. The accompanying vein, however even in extensive disease may be perfectly normal. At times a normal vein may be completely encircled by the loops of distended vein (Fig. 5)

Often the varicosities will involve a limited area of the vessel the segments above and below it remaining perfectly normal. On the other hand, what appears on physical examination to be a limited varicosity will be found to be an extreme case wherein only the most superficial loops are visible to the naked eye. In a few of our cases, localized bulbous enlargements of the calves were found to be due to extreme dilatation of the vessels which were somewhat masked by the adipose tissues. The futility of attempting to accomplish a cure by conservative treatment or by limited injections is obvious (Figs. 6 and 7)

The typical valvular mechanism of the venous system is not demonstrated to any great extent in varicose veins. Residual valvular structure may be represented as unilateral linear filling defects in the contrast media or at the site of localized bulbous swellings in the course of the vessel.

We have examined our patients in the upright, vertical, and Trendelenburg positions. Satisfactory studies may be made in the horizontal position since venous stasis even in this position is so marked that the dye remains practically motionless for a considerable period after injection. In moderately severe cases, without the use of a tourniquet and with the patient in this position retrograde circulation occurs and concentration of the dye results. The incompetency of the valves of the superficial system (Trendelenburg positive) is thus simply established. This observation is of practical importance in considering the efficacy of sclerosing mixtures. We injected skiodan above or proximal to the ulcers, and retrograde obliteration of the vessel occurred with healing of the ulcer. In most instances it would seem preferable to inject the veins somewhat proximal to the segment to be obliterated.

The centrifugal flow of disordered venous circulation may be studied most characteristically with the patient in the upright position. All of the morphological and physiological alterations referred to are present to an exaggerated



Fig. 8. Venous angioma of the neck injected with skiodan.

degree. These changes have already been described and it becomes necessary only to refer to another phenomena. The formation of loops is a characteristic of the disease. They are usually so placed that their ends are upward toward the heart. The development of stagnant venous lakes is thus favored within which distinct fluid levels may be demonstrated. In this situation stasis, extreme and concentration of the dye pronounced.

At times moderate dilatation of a vein occurs but no retrograde circulation results. This is due to the fact that the valvular mechanism is still intact (Trendelenburg nil). Under fluoroscopic observation after injection, it will be noted that the dye is transported centripetally at a somewhat retarded speed. Venoscopy in this instance will show slight dilatation of the vessel but no marked distortion in its contour. To test the mechanics of the Trendelenburg negative (incompetency of the valves of the communicating system) would have necessitated exposure of the deep veins and injection with skiodan. This procedure was not considered justifiable in any of our cases.

Pressure applied by the palpating finger or represented by the force of contracting muscles rapidly spreads the skiodan throughout the venous channels in a manner that demonstrates the break down of the regulating mechanism. The communicating and deep veins may be quickly filled and the venous trunk visualized for a distance of 4 to 6 inches. Most of the dye will be projected peripherally to remain for a considerable period in remote venous loops. Some of it may be forced upward to pursue a tortuous and devious route to the heart. Where extensive disease exists, it is surprising to observe the

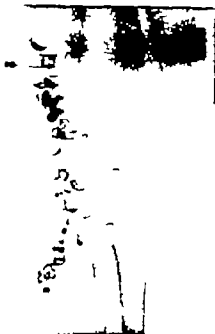


Fig. 9. Plate taken in upright position and showing horizontal fluid levels.

degree of force necessary to empty the venous channels completely.

It is agreed and accepted that respiratory movements assist circulation. If varicose veins exist we have found that respiratory movements are wholly ineffectual in emptying the superficial vessels. Whatever aid to the circulation these movements have, is apparent only after the blood enters the deeper veins. Of the respiratory phases, forced expiration appears to be a decided factor in assisting the flow in the deeper vessels. Deep inspiration, since it is accompanied by increased intra-abdominal pressure, is of no material aid to the circulation.

VENOUS ANGIOMATA

During the course of this investigation, a patient with an extremely large venous angioma of the neck presented herself in the outpatient department. The veins were so distended that they formed a large unsightly tumor. She refused operation and skiodan was therefore injected and the mass studied by means of stereoscopic plates. The angioma consisted of innumerable convoluted and dilated vessels so closely intertwined that identification of individual loops was difficult, and their point of origin from the local venous system impossible to determine. Segaliter and his workers described the appearance of a

hemangioma after injection of sklodan and subsequent obliteration by a hypertonic sugar solution. Our own case showed practically complete obliteration of the angioma 3 days after the injection of sklodan, without the use of any other agent. In this instance, the sklodan served a double purpose. It permitted us to visualize the angioma and at the same time acted as a sclerosing agent the effect of which was as satisfactory as that obtained by any of the other chemicals employed for this purpose and produced less reaction than sodium chloride, sodium salicylate, or their derivatives (Fig. 8).

SEQUELÆ

In none of the patients was there any untoward effect. It is axiomatic, of course, that intelligent employment of any intravenous medication demands its introduction into the vein and not into the tissues about it. Fortunately there are no difficulties in entering varicose veins and in none of our cases did any of the chemical get into the perivascular tissues. No sloughs were therefore produced.

By this method, an occlusion of many vessels was rapidly accomplished particularly in those cases with a Trendelenburg positive. The venous angioma referred to was sclerosed in 3 days. In another patient 4 inches of the vein was collapsed 24 hours after treatment. In the 48 cases that were studied, the obliteration of the vessel appeared to be somewhat faster with sklodan than with other salts.

One of our cases was extremely instructive. This patient had an ulcer about $1\frac{1}{4}$ inches in diameter over the internal malleolus, which had

persisted for 9 years. Her veins were injected in the calf and the ulcer healed completely in 19 days. The retrograde circulation and sclerosing effect of the chemical was thus beautifully illustrated.

CONCLUSIONS

The injection of sklodan into varicose veins offers a safe method of visualizing the venous system. By the use of this chemical during fluoroscopy we are able to observe the circulation of the blood in diseased veins and its variations during changing mechanical conditions. The static implications of the Trendelenburg test, observed by this method by McPheeters, have been confirmed by us. By the use of stereoscopic plates we can record the physical conditions of the veins at the time of injection. The use of this chemical results in sclerosis of the affected vein which is painless and unaccompanied by periphlebitis. We have demonstrated to our satisfaction, the presence of venous pools and feeder veins in the vicinity of varicose ulcers.

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THE EVALUATION OF SODIUM MORRHUATE THERAPY IN VARICOSE VEINS

A CRITICAL STUDY¹

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THE introduction of any new agent in therapeutics is invariably hailed with enthusiasm. Following this, comes a period of reaction during which the new method is either crushed by criticism or rises anew to take its place on a firmer foundation. Sodium morrhuate has passed its first wave of optimism and the time is now ripe to assay its true value.

My interest in this preparation was stimulated in 1930 when Higgins and Kuttel published their experiences in the *Lancet*. Their claim that sodium morrhuate was a sound proof especially intrigued me since I had been using a dye method of injection in order to avoid this complication. Accordingly I used the new solution in practically every private and clinic case up to the present time and herewith present an evaluation of its merits based on a detailed study of 561 injections. Altogether 1000 injections were given, but all of these were not tabulated since it was felt that the number of treatments recorded amply bore out the claims presented.

CHEMISTRY

Originally the name "morrhucic acid" was given by Gautier and Mourgues to a nitrogenous putrefaction product, hydroxyethylpyridine butyric acid ($C_9H_{13}NO_3$) found in rotted cod liver oil. Lately the name sodium morrhuate, has been used as an elegant synonym for cod liver oil soap prepared for intravenous injection by the methods devised by Ghosh (1920) or Cutting (1926).

In other words, sodium morrhuate is a mixture of sodium salts of the fatty acids contained in cod liver oil. To understand sodium morrhuate, one must know the composition of cod liver oil. It is a well known fact among chemists that the make up of cod liver oil is still largely unknown. While the existence of many fatty acids has been established others are mere conjectures, and no chemist in recent years has attempted a quantitative separation.

A partial list of these fatty acids includes myristic, palmitic, palmitoleic, stearic, oleic, erucic, therapeutic, and others too numerous to mention. Most of these are unsaturated and therefore unstable. Furthermore, the degree of

unsaturation of a particular sample of oil, which of course depends upon the proportion of individual acids present in the sample, varies with each batch tested. This variation in oil depends again upon factors beyond our control, such as the feeding ground of the fish, the season of the year and the sexual difference.

Such is the basic material from which sodium morrhuate is prepared for intravenous use in varicose veins. It is not surprising therefore that the results secured present such wide fluctuations in efficiency.

Sodium morrhuate, itself is a yellow powder of plastic odor and greasy soapy feel. It dissolves in water to make a light yellow solution that lathers like ordinary soap on agitation. On exposure to air in solution, the mixture is unstable forming a fine white cloudy precipitate in one week. Cutting, who prepared this solution for the treatment of tuberculous, made the claim that even in sterile amber bottles, tightly sealed, this mixture does not keep well deterioration of the drug occurring in a week. His implication was that the efficiency of the drug for use in tuberculous became impaired on standing. It would, therefore follow that the chemical action of sodium morrhuate in vascular obliteration might conceivably also suffer with age.

Powdered sodium morrhuate, on the other hand, darkens on standing and becomes resinous in a few days. Even in the absence of light and moisture, deterioration takes place and an insoluble product forms. It is clear therefore, that a solution is the better method of keeping this agent. Since oxidation is the probable factor involved in deterioration, it follows that an oxygen-free medium is the method of choice for preservation.

Thus at the very outset, one is faced with the discouraging thought that the agent under investigation has an unknown variable composition, and that its stability is difficult or impossible to maintain.

It has been claimed that sodium morrhuate is a close approach to the ideal varicose vein solution. Before we decide whether it merits this distinction let us study the postulates for an ideal solution.

TABLE I

| | Product A | | Product B | | | | Product C | | Product D | |
|-------------------------|--------------------------|----------|--------------------------------|----------|-------|----------|--------------------|----------|--------------------------|----------|
| | NaMl 1/2 per cent phenol | | NaMl 5 per cent benzyl alcohol | | | | NaMl unadulterated | | NaMl 1/2 per cent phenol | |
| | Cases | Per cent | Cases | Per cent | Cases | Per cent | Cases | Per cent | Cases | Per cent |
| Very good result | 0 | 0 | 30 | 16 | 0 | 0 | 0 | 0 | 0 | 0 |
| Good result | | 5 | 51 | 45 | 30 | 52 | 8 | 54 | 33 | 35 |
| Fair result | 2 | 18 | 16 | 30 | 5 | 4 | 14 | 8 | 6 | 0 |
| Slight result | 15 | 15 | 18 | 1 | 9 | 19 | 23 | 22 | 3 | 5 |
| No result | 42 | 42 | 15 | 8 | 24 | 42 | 24 | 16 | 18 | 30 |
| Total No. injections | 96 | | 180 | | 75 | | 150 | | 60 | |
| Successful injections | 30 | 40 | 147 | 81 | 43 | 57 | 23 | 62 | 30 | 66 |
| Unsuccessful injections | 57 | 60 | 33 | 9 | 32 | 44 | 27 | 18 | 21 | 25 |

NaMl = sodium morrhuate

REQUIREMENTS OF AN IDEAL SOLUTION

The ideal varicose vein obliterating agent should have the following characteristics

1. Incapability of slough formation
2. Freedom from pain on injection
3. Efficiency as an endothelial irritant
4. Non-toxicity in reasonable amounts
5. Purity and standardization of constituents.

None of the solutions previously in use answered these requirements. The following study was made in order to determine whether sodium morrhuate fulfills these demands.

RESULTS OF SERIES

Table I represents a summary of 561 injections. Four preparations were studied. Their composition was as follows. Product A was a 5 per cent solution of sodium morrhuate with 1/2 per cent phenol. Product B was 5 per cent sodium morrhuate with 5 per cent benzyl alcohol added. Product C was 5 per cent sodium morrhuate without any adulterant. Product D was again 5 per cent sodium morrhuate with 1/2 per cent phenol.

The sources of these preparations were the following. Product A was made by an American firm that imported powdered sodium morrhuate from England and subsequently dissolved it in water with the addition of 1/2 per cent phenol. Products B and C represented American preparations manufactured in one operation at the same plant. Product D was made in England, and the finished product distributed in America.

The effects of the medication were indicated by five headings, depending upon the severity of reaction produced. These headings were arbitrarily designated as follows: 'very good result,' 'good result,' 'fair result,' 'slight result,' and 'no result.' The designation 'very good result' was

given to a spreading periphlebitis accompanied by edema, pain, and disability. A good result was defined as a firm tender thrombosis, attended by a moderate degree of pain and slight periphlebitic involvement. A fair result was classified as a definite thrombosis without spreading or discomfort. A 'slight result' was noted if the thrombosis was incomplete. The classification, 'no result' is obvious.

This rough division proved sufficient for our study, although it must be admitted that there was no sharp dividing line between the types of reaction produced.

The technique employed in this study was uniform throughout. The injections were made with the patient in the standing position and no tourniquets were used. All cases of phlebitis were excluded in order that the vascular reactions obtained should be dependent only upon chemical irritation. In regard to dosage, the vast majority of injections were in 2 cubic centimeters quantities, except for those cases discussed below.

Product A (sodium morrhuate with 1/2 per cent phenol) was used in 96 injections. As can be seen in the table, varying grades of reaction were secured. Practically speaking only 43 per cent or less than half of the injections made were efficient from a clinical standpoint. These poor results were particularly significant since the ampules secured were fresh and used almost immediately. This preparation was never used again since it was definitely felt that a solution made from an imported powder was inferior in quality.

Product B (sodium morrhuate with benzyl alcohol) was studied in two parts because two different batches of sodium morrhuate from the same source were tested against each other. The first batch consisted of a shipment of ampules

which was used for 180 injections. From the second batch 75 injections were made.

Among the reactions produced by the first shipment of ampules, 30 injections were labeled, "very good result." 15 of these reactions were attributed to high dosage, namely 5 cubic centimeters of solution. The 15 others could not be accounted for by massive dosage since no more than 2 cubic centimeters was used. Eighteen per cent of the treatments were failures. Altogether 81 per cent of the injections in this group gave definite thromboses and did not need repetition. These variable results showed how inconsistent sodium morrhuate was in its action. In fact different degrees of irritation were secured on the same leg of the same patient at succeeding intervals. It should also be noted that this group of ampules produced the highest percentage of successful injections in our study.

There were no severe reactions produced from the second shipment of ampules of Product B. Briefly 56 per cent were clinical successes and 44 per cent failures. When this result is contrasted with the 81 per cent of successful takes in the first batch from the same manufacturer it is evident that there is a definite variability as to the potency of the different shipments from the same source.

With Product C which consisted of unadulterated sodium morrhuate solution, 150 injections were made. This solution came from the same source as Product B. It was made at my request in order to determine the advisability of using sodium morrhuate in a pure form. It took 4 months to complete these 150 injections. However at the end of this time only a few ampules showed the characteristic whitish flocculent precipitate indicative of chemical changes. The number of decomposed ampules in this group was, however, no greater than occurred with the ampules containing benzyl alcohol.

The amount of local pain at the site of injection was tabulated in each case and again it was noted that there was no difference between this preparation and the one with benzyl alcohol. There were a few cases of perivascular injections in this group which were easily detected because of the immediate, sharp burning pain produced. This danger signal was less intense in the solutions adulterated by local anesthetics. The operator was thus better able to detect his mistake and rectify it. According to this experience, it is felt that the addition of benzyl alcohol or phenol is inadvisable as a local anesthetic. Furthermore, the toxic effect of these adulterants must not be lost sight of especially where large or

oft-repeated smaller injections are made. In regard to the thrombotic efficiency of unadulterated morrhuate solution, the table shows 62 per cent of successful results. There was evidently no loss of efficiency when local anesthetics were excluded from the mixture.

Product D (sodium morrhuate with $\frac{1}{4}$ per cent phenol) can be dismissed rapidly with the observation that this English product did not differ from the American preparation.

A general observation made on all the products tested was that the percentage of "good" or "fair" results decreased in rough proportion to the age of the ampule. With each preparation tested it was noted that the first few dozen gave the promptest and most efficient reactions. The cases labeled, "slight" or "no result" were always in greater number toward the end of each series.

In all, ten extravascular accidents occurred. Of these, two sloughs developed. One occurred in an area of poor tissue resistance near the site of an old healed ulcer. The other took place after the injection of $3\frac{1}{2}$ cubic centimeters of sodium morrhuate into the thigh in an attempt to obliterate the great saphenous vein. These sloughs were preceded by the characteristic bleb formation and their subsequent course was as usual. Thus, sodium morrhuate can definitely cause slough formation although with much less frequency than the other varicose vein irritants.

I did not encounter the complication of skin eruption at any time. Dr W. M. Cooper in a personal communication, reports the occasional occurrence of a mild to moderate dermatitis with annoying pruritis. He states that this is a transitory reaction and can be ameliorated with the usual antipruritic lotions. In his opinion, the use of large quantities of solution, namely 10 cubic centimeters or more, was responsible for the cases of skin eruption he saw. Since I have never used over 5 cubic centimeters, this complication is unknown to me.

The above study would indicate that phenol or benzyl alcohol is unnecessary as a local anesthetic. The absence of deterioration in the unadulterated sodium morrhuate ampules indicates that the employment of these agents as a chemical preservative is also unwarranted. However the advisability of including these adulterants in the mixture for their antiseptic action is a debatable question.

In a personal communication from one of the first users of sodium morrhuate for vein therapy Dr T. T. Higgins states his agreement that the addition of a local anesthetic is unnecessary.

However in regard to the addition of an anti septic, he writes

I have been guided entirely by the chemists and have always understood from them that it is advisable to add to the solution a trace of antiseptic like 0.3 per cent tricresol. This addition is advisable, I understand, to prevent a possibility of bacterial growth and not to prevent chemical decomposition.

A letter to an American manufacturer of ampules brought the following reply

I have been making preparations of this character for the past 30 years and have never felt it necessary to add preservatives, such as phenol or benzyl alcohol to intravenous solutions. We avoid the need of preservatives by extreme care in the preparation of our solutions and careful sterilization of the sealed ampules.

An inquiry directed to the manufacturer of one of the products tested in this study brought this response

As mentioned in our previous correspondence, Kilbourne in his recent paper stated the fact that sodium morrhuate is not self-sterilizing. As a matter of fact, the English were the first ones to use sodium morrhuate as an obliterative agent and they had $\frac{1}{2}$ per cent phenol in their solution, undoubtedly for the same reason. Phenol is very toxic and is a blood coagulant. Benzyl alcohol is of low toxicity, does not coagulate the blood, and is not an alcohol of the type of methyl or ethyl alcohol.

As to the process of manufacture, we use a modification of R. A. Cutting's method, published, June, 1926. The preparation of the ampule solution does not differ from any of our usual ampule preparations, in so far that it is filtered under sterile conditions and filled into sterile ampules which have been sealed and sterilized.

Since the sealed ampules of sodium morrhuate are sterile, the addition of benzyl alcohol is not necessary as long as the ampule remains sealed.

There is thus a diversity of opinion as to whether an antiseptic is necessary to keep the solution sterile. Since it has been shown that pure unadulterated sodium morrhuate is the better preparation therapeutically, it is certain that if it can be prepared in a sterile manner without the use of antiseptics, this method should be encouraged. It is equally certain that more study on this question is necessary.

Summing up the results of the series, the following points may be enumerated

DISADVANTAGES OF SODIUM MORRHUATE

- 1 Sodium morrhuate is not of uniform chemical composition.
- 2 It is not uniform in its therapeutic action.
- 3 It is not completely stable in solution.
- 4 Its potency diminishes with age.
- 5 The use of local anesthetics in the mixture is unnecessary and inadvisable.
- 6 It is capable of slough formation on perivascular injection.

7 There is some question as to whether it can be prepared aseptically without the use of antiseptics.

ADVANTAGES OF SODIUM MORRHUATE

- 1 Non toxicity in therapeutic amounts.
- 2 A relatively small percentage of sloughs follow its use.
- 3 Little local pain.

These conclusions apparently point unfavorably toward the continued use of sodium morrhuate in its present form. Yet, curiously enough the writer is of the opinion that from this haphazard mixture an ideal solution can be developed. This can only be done by the isolation in pure form of the active ingredients in the combination. The author has begun this task but needless to say has only scratched the surface, much more work remains to be completed.

Before going into a discussion of the purification of sodium morrhuate, the mode of action of this agent must be explained. Many suggestions have been offered as to why sodium morrhuate is effective but none was satisfactorily understood. The best explanation has been that this cod liver oil soap irritates by virtue of its low surface tension action, which is part of its 'soap effect.'

To prove this point the author prepared a sterile solution of ordinary commercial liquid soap. This diluted sterile solution, which is also a mixture of unsaturated fatty acid salts was injected into the central vein of the ears of two rabbits. In two days, a typical firm thrombosis occurred in each case just as with sodium morrhuate in the human subject. This indicates that apparently other soap solutions can cause endothelial irritation. Therefore, sodium morrhuate does not produce its effect on account of any characteristic peculiar to it alone. In other words, it should be possible to prepare a pure and known fatty acid salt solution which will have the advantages and none of the disadvantages of sodium morrhuate. The final perfected product might conceivably contain only one purified salt, or it might be a mixture of the most effective, combined advantageously.

That this is not mere hypothesis was shown by the following experiment

A 5 per cent solution of sodium oleate which is one of the chief constituents of sodium morrhuate, was secured from the Crookes' Laboratory. Toxicity tests were performed by the intraperitoneal injection of 10 rabbits, weighing about 2 pounds apiece. The amounts used ranged from 1 to 10 cubic centimeters. Eight animals received up to 5 cubic centimeters and 2 rabbits,

THE CHANGING ATTITUDE TOWARD ILEUS

WHEN first seen by the surgeon the patient with ileus presents a picture often complex, though a clue as to the origin of the condition can frequently be obtained from a history of similar attacks of less severity of previous intra abdominal infection or of a more or less remote abdominal operation. These facts may imply the probability that the ileus had its inception as a mechanical obstruction. On the other hand the occurrence of ileus during a hospital stay following an abdominal operation is ordinarily started by segmental paralysis of the intestine adjacent to residual infection or less commonly to knuckling or twisting of a loop by an adhesion which has not yet gone through the full process of absorption. Regardless of the original mechanism of interference with gastro-intestinal function at any given level the picture of full blown ileus becomes the same for all cases, since distention itself leads to loss of tonus of the intestine. It is at this point that until recent years our knowledge of the physiological derangement of ileus stopped short. As in other fields of medical investigation research on the ultimate cause of death led first to a fuller understanding of the chemical as opposed to the physiological imbalance. Even now the fact that obstruction itself is not the cause of death is not fully appreciated although replacement therapy with the provision of water sodium chloride, and calories has become generally practiced as adjuvant treatment.

Emphasis is now being placed on certain important factors which have been widely disregarded and new facts have been added to our knowledge of the mechanism of the development of and recovery from ileus. While it has long been recognized that the paralyzed

loop of gut lying next to and perhaps forming the wall of an abscess acts like a mechanical obstruction to the intestine only recently is the view gaining acceptance that the final factors in mechanical obstruction are usually edema and spasm of the gut itself. That is to say patients who have a chronic incomplete obstruction are thrown into a state of acute, more or less complete obstruction by gross indiscretions in diet abuse of cathartics, and similar indiscretions. There is ample evidence that the edema and spasm at the site of obstruction accountable for the acute stage need be only temporary for on no other basis can the history of previous obstruction crises with spontaneous recovery or recovery after enterostomy be explained. The prime necessity is obviously twofold (1) to empty and to keep continuously empty the obstructed intestine of fluid and gas in order that structural damage to the bowel wall may be avoided, tonus recovered and spasm and edema allowed to subside, and (2) the prevention of fatal chemical derangement by replacement therapy. The danger of too rapid release of distention has recently been suggested by studies on intra intestinal pressure, from which it appears that absorption through the distended intestine is practically nil due to the decrease in venous and lymphatic drainage but that it may quickly increase if distention is suddenly released. The evidence is not yet conclusive but appears to support similar clinical observation on fatalities subsequent to enterostomy.

Using a modification of the apparatus for continuous suction from the stomach first described by Robertson Ward in 1929 we have made observations for more than 2 years on the early events in the development and subsidence of ileus, including cases having their origin in mechanical obstruction. Not only does the apparatus decompress the intestine

gradually and keep the obstructed gut effectively emptied but it provides a means whereby one can study the variations in the physiological status of the intestine in ileus by measuring the rate of flow of secretion from the intestine into the stomach, which is demonstrably increased at any time by stopping the suction temporarily and by allowing the patient to drink. Continuation of suction results in a progressive diminishing of this flow until a standstill is reached and only ingested fluid, and no more, is recovered by suction. After varying periods, depending on the origin of the ileus (infection or mechanical obstruction), the flow of ingested fluid moves through the pylorus in progressively larger percentages and at an increasing rate. We measure the flow in terms of cubic centimeters per hour and can thus chart graphically the direction and rate of flow per unit of time. We have termed this the *pyloric balance* and speak of it as being negative when the gut is emptying itself into the stomach and positive when the stomach is emptying ingested fluids into the gut. We have also found that after peristalsis has disappeared tonus is retained to a degree that permits recovery of normal gastrointestinal function on this regimen. Peristalsis, audible to prolonged auscultation, reappears only after obvious restoration of the physiological continuity of the gut.

Early operation for intestinal obstruction has traditionally been urged and when the case comes to the surgeon within a very few hours of onset a mortality of as low as 5 per cent has been reported. In only rare instances is a surgeon able to report any considerable series of cases seen at such a time by himself. The entirely praiseworthy effort to urge early operation has had the effect, not of stimulating the physician in general to get the patient to the hospital as soon as possible but of inducing the surgeon to operate as soon as the

operating room can be got ready after the patient enters the hospital, regardless of how long the obstruction has been present, regardless of the probable site and nature of the original lesion, regardless of the physiological status of the intestine, and as well the chemical and metabolic status of the patient. It is probably fair to say that a single gastric lavage and an intravenous injection of physiological salt and glucose solution represent the average of good pre-operative treatment. The inevitable result of such treatment, however, is the publication of mortality statistics of from 40 to 60 per cent in all large series of cases year in and year out collected from many large general hospitals.

Primary suture after resection of obstructed gangrenous intestine is now almost universally condemned but is still practiced not uncommonly. With exploration being done in an overwhelming majority of patients with ileus in the fear that gangrene may have set in, the result is approximately half of those who undergo operation die whereas gangrenous gut is found in less than 5 per cent of cases excluding those with external hernias. The confusion in reasoning is obvious. There is an increasing number of surgeons to whom it is clear that, in view of the newer facts of the physiology of ileus, the patient, unless seen very early is safest on decompression and replacement therapy with close observation of the pyloric balance until it is at least no longer grossly negative. Then, if necessary, operation may be performed with the patient in approximately a normal physiological status but operation may actually be unnecessary unless the original obstructing mechanism be a stricture, if mechanical, or a definite abscess demanding drainage, if infectious in nature. The plan of decompression is only temporarily practicable in cases with very high obstruction, due to the enormous

outpouring of high intestinal secretions, and in those obstructions in the colon in which the ileocecal valve is competent (which is not often the case in our own experience), how ever cases of external hernia are naturally excluded.

As series of cases sufficiently large to be significant are accumulated it is our belief that a reduction in the mortality from ileus will have been accomplished for the first time in the past quarter of a century

WILLARD BARTLETT JR.



VALENTINE MOTT
1785-1865

MASTER SURGEONS OF AMERICA

VALENTINE MOTT

A BRILLIANT and ingenious colonial surgeon of Quaker descent son of a physician and father of an eminent surgeon Valentine Mott was born in Glen Cove Long Island, August 20 1785 Reared in an atmosphere of medical science he readily adopted the avocation of his forbears and soon attained international fame for his surgical skill and clinical wisdom Completing his classical education under the guidance of private tutors at the age of nineteen years, he embarked on his medical studies at Columbia College, which institution conferred on him two years later in 1806, his medical degree

Desirous of more advanced surgical training Mott continued his studies abroad, and first placed himself under the tutelage of Sir Astley Cooper After remaining for some time in London he journeyed to Edinburgh and, for more than a year, attended the lectures and demonstrations in surgery and surgical anatomy in this center of medical learning Five years from the time he enrolled in Columbia College as a medical student, he returned to New York and established himself in the practice of surgery

In 1810, the year after his return, he accepted the chair of surgery in his alma mater, Columbia College, which he retained for three years until the school was reorganized and the College of Physicians and Surgeons founded He continued his professional duties in this new institution without interruption until 1826 At this time discord arose among the faculty members and Mott, with a few of his colleagues, founded a new medical school in connection with Rutgers College Unfortunate legal difficulties forced him to abandon this project, however, and in 1830 he returned to the College of Physicians and Surgeons as professor of operative surgery and surgical and pathological anatomy His life was unusually active and useful until 1835, when waning health caused him temporarily to abandon his duties The subsequent six years were largely devoted to European travel which included close attendance to many of the most famous surgical clinics on the continent By this time Mott enjoyed a wide reputation as an astute and able surgeon, particularly eminent for his original work in the field of vascular surgery Completely restored to health, he returned to New York in 1841 to become the principal founder of New York

University Medical College in which institution he filled the chair of surgery and relative anatomy as well as being president of the faculty. At the age of sixty-seven years he was made emeritus professor lecturing to the students occasionally until his death from angina pectoris thirteen years later April 26 1865.

Characteristic of all pioneers who venture into unexplored fields, Valentine Mott was a bold though careful operator with an imaginative and intuitive mind and possessed of unusual technical skill. Handicapped during most of his life by the difficulties and dangers attending surgical maneuvers prior to the discovery of ether and the development of bacteriology his operative innovations were, of necessity largely limited to rapidly performed procedures which did not necessitate entry into the abdomen. During his later years, however the frequency and enthusiasm with which he employed ether anaesthesia aided materially in the universal acceptance of this great boon to surgical progress.

Mott's most fruitful and original work pertained to surgery of the blood vessels. His first claim to renown came at the age of thirty-three when he, for the first time ligated the innominate artery for aneurism of the right subclavian artery. Unfortunately the patient succumbed several days later following hemorrhage from an adjacent vessel eroded secondarily by infection. Incidentally it was almost half a century later before this operation was successfully performed. In 1827 Valentine Mott was the first to ligate the common iliac artery for aneurism of the external iliac, placing the ligature within half an inch of the aorta. Another of his original contributions to vascular surgery was excision of several inches of the deep jugular vein which was involved in a tumor mass. This required ligation of both ends of the vein something hitherto unattempted. He also made numerous advances in the repair of traumatic lesions of the large veins which he closed with fine sutures without occluding the lumen of the vessel. In all he tied the common carotid artery forty-six times.

Mott's endeavors were by no means limited to surgery of the blood vessels, as he also contributed much to orthopedic and plastic surgery. In 1821 he resected the right maxillary bone for osteosarcoma, having first ligated the common carotid to prevent excessive hemorrhage. Several years later he successfully performed an amputation at the hip joint. In 1828 he removed the right clavicle which was involved with a large sarcomatous tumor an operation which won him considerable fame and was long known as "Mott's celebrated case." The operation required nearly four hours for its completion and in Mott's own words was the most tedious, difficult and dangerous procedure ever undertaken by him. He was the first surgeon to devise a cure for "cleft spine," accomplished by extirpation of a tumor at the lower end of the spine. Later he performed a similar operation in the region of the neck. He was unusually adept in restor-

ing the normal contour and appearance of the cheeks, lips or nose following disfiguration incident to the excessive use of mercury

Endowed with great physical vigor and conscientious devotion to his profession, Valentine Mott was a prodigious worker. During his entire busy and practical life he continually enlarged and refreshed his knowledge of normal and pathological anatomy by dissection and postmortem examinations despite the legal hindrance incumbent upon such practice. It is said that before each new or important operation he first tried his contemplated procedure upon the cadaver. There were few operations known in his time that he did not perform. He was one of the foremost lithotomists of his day, operating for stone 165 times with a mortality rate of less than 4 per cent. In one instance he removed a stone weighing more than seventeen ounces. He is credited with more than a thousand amputations. For fifteen years he was senior consulting surgeon to Bellevue Hospital and for varying periods served in a similar capacity for St. Lukes, the Hebrew, St. Vincents, and Women's Hospital. "His success in capital operations was due not simply to his surgical knowledge and skill, but in a large measure to his care in the after treatment of the patient and to a knowledge of therapeutics that brilliant operators rarely possess." Although performing as Sir Astley Cooper said, "more of the great operations than any man living or that ever did live," he remained a staunch advocate of conservative surgery.

Mott contributed some twenty five papers on various surgical subjects to the literature of his day. He augmented the American edition of Velpeau's *Surgical Anatomy* with many notes and illustrations from his own works. He was the recipient of numerous honors, including fellowship in the Imperial Academy of Medicine of Paris, the Medical and Chirurgical Societies of London and Brussels, the Paris Clinical Society, and Kings and Queens College of Physicians of Ireland. For many years he was president of the New York Academy of Medicine. Unfortunately most of the valuable specimens of his anatomic museum were destroyed by fire shortly after his death. His wife succeeded in gathering the remaining ones together, however along with a large share of his library and other mementos and established the Mott Memorial at 64 Madison Avenue, New York City. Unfortunately, this memorial is no longer in existence, although the New York Academy of Medicine became heir to the Mott Library.

JAMES T. PRIESTLEY

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

THE book on *The Art of Anæsthesia*¹ by Flagg, a recognized authority on general anæsthesia, has been used for 16 years. The introduction gives a brief history of anæsthesia with interesting illustrations.

This, the fifth edition, as were former ones, is in two parts. Part 1 bearing upon the classification of anæsthesia, its characteristic signs, and its administration by the various methods and agents ordinarily employed is the same as in the previous edition except a chapter on ethylene is added and the chapters on regional and spinal anæsthesia are brought up to date both as to methods and agents employed. A criticism the author makes on the use of regional and spinal anæsthesia is that the technique is more readily acquired by the surgeon than that of general anæsthesia and as a result the one method is used to the exclusion of all others. This serves to bring the regional and spinal methods into disrepute.

Part 2 of the book treats of the factors incidental to the actual administration of the anæsthetic.

The chapters on premedication, postoperative care of the patient and carbon dioxide are unchanged, but considerable new and valuable material has been added to the chapter on the selection of the anæsthetic and the method of administration. A full new chapter is devoted to the improved technique for intratracheal anæsthesia.

The author describes the technique for intubation and tells of the complications and how to meet them. Then follows a summary of the advantages and disadvantages of intratracheal anæsthesia.

A new chapter on 'Newer Methods of Artificial Respiration,' lucidly describes the four methods available in cases of asphyxia or respiratory failure.

This book is an excellent text for all students of anæsthesia as well as for surgeons and internists.

MIRIAM KROVITZ.

THE publication of this volume by Bailey² performs the very useful service of recapitulation and bringing together into one volume not only the symptoms, the disordered histological characteristics and the treatment of intracranial neoplasms, but also considers, often in great detail, the embryology

anatomy—both human and comparative—and the physiology of the various structures within the calvaria which may be affected by these new-growths.

As would be expected from this author the pathological changes which characterize the various types of neoplasms are admirably dealt with and afford one of the most brilliant and satisfying features of a volume which should be of great value to the medical undergraduate and the practitioner of neurology and neurological surgery.

The chapters which consider the new-growths which may arise in any of the various parts of the brain do so in connection with functional areas thus emphasizing the physiology of the cortical, subcortical, and ganglionic regions while the more specialized neoplasms such as the acoustic neuromas, the hypophyseal adenomas, the pharyngeomas, and the pinealomas are the subjects for special chapters as are also the tumors arising from the intracranial connective tissue, the vascular structures and miscellaneous and metastatic neoplasms. In this way the author presents the more important facts connected with this most intricate system of organs without devoting any special chapter or chapters to the subject of cerebral localization and function.

The preliminary chapters deal with the general problems presented by brain tumors, the structure of the cranium and its contents, and considerations of a general physiological nature such as the circulation of the blood and the cerebrospinal fluid. General and differential diagnosis and the treatment of cranial and intracranial tumors constitute the subject matter of the concluding chapters.

Many invaluable tables, schemata, classifications, and tabulations which have appeared in scattered publications by the author and his former illustrious collaborator—Dr Harvey Cushing—are gathered together in this volume and thus become readily accessible to the reader. The graphs representing the age distribution of intracranial tumors, of gliomas, medulloblastomas, subtentorial tumors, and gliomas above or below the tentorium are especially illuminating.

The format of the book is in the majority of features very satisfactory. The publishers and the author have elected to use a semi-rough uncoated paper which is restful to the eye and permits a volume of considerable size to be of only moderate weight but it renders impossible the use of half-tone illustrations and necessitates the use of pen and ink drawings. It cannot be said that all of these are

¹THE ART OF A. KETTER. 5th rev. ed. By F. J. Flagg. Philadelphia and London. J. B. Lippincott Company. 515.

²INTRACRANIAL TUMORS. By Percival Bailey. Springfield, Illinois, and Baltimore, Maryland. Charles C. Thomas, 1915.

works of art and some of them are definitely unpleasant in their execution. One would also wish for photographs of specimens—both gross and microscopic—since these always convey a greater sense of verisimilitude. The use of this kind of paper also necessitates outlines instead of prints from roentgenograms. Only a very few typographical errors have evaded the scrutiny of the proof readers. One illustration would seem to be definitely mislabelled.

The majority of the chapters still contain—it is not clear whether intentionally or not—indications that the various subdivisions of the book have at one time or another been presented in lecture form or as clinical presentations. To the reader this is distinctly unpleasant and detracts very materially from the dignity of the publication and spoils the effect of the presentation of otherwise admirable material.

There are a number of dogmatic assertions of which any lecturer is always guilty but which should never be allowed to find their way into a published work. These are scattered rather widely throughout the book and notice should be taken of a number of them since they would certainly seem likely to mislead the student. On page 58 in discussing lesions produced by occlusion of the middle cerebral artery the author presents a number of definitions which may have individual supporters, but certainly have not acquired full acceptance by neurologists in general.

In discussing the well known effect of neoplasms of the pual region in destroying the function of vertical conjugate movements of the eyes the author states that paralysis of conjugate movement of the eyes occurs only as a result of involvement of the tectum mesencephali ignoring the possibility of this symptom being produced by involvement of the vertical oculogyric pathway in the subthalamus. The loss of vertical gaze is an important component of the syndrome of the subthalamus also. The statement that occlusion of the pre rolandic artery (when on the left side) causes an intense alexia without hemianopia "may occasion some surprise.

In view of the general high excellence of the treatment of clinical phenomena and the physiology of the cortex and other parts of the brain, it is to be regretted that many theories still in a highly debatable and controversial state are too categorically and dogmatically presented.

After devoting nine pages to a critical discussion of the aphasias and in many instances making quite restricted localization for the varying types of aphasia and associated difficulties the author concludes that "in actual practice the aphasic symptoms are often deceptive and must not be relied upon for too restricted localization in cases of cerebral tumor.

Considerable space is devoted to the still largely hypothetical function of the hypothalamus and the author concludes after an extensive discussion, that there is at present no consensus in regard to these structures and that it is improbable that any attempt to assign specific functions to these nuclei will succeed. The statement that the basal regions of the

brain must exert a regulating influence upon the cortex and that an anterior group of nuclei excite and another group about the superior posterior part of the third ventricle calm and quiet the cortex may be accepted with some caution.

It is a question whether the inclusion of such a mass of detail and the presentation of so many contested theories and highly debatable minutiae does not serve to confuse the student and distract his attention from much of the most praiseworthy material which may be found in this book. The volume attempts to present the last word in regard to many topics and in this way it does not fulfill its avowed purpose of being a book adapted to the needs of the medical student beset as he is with all of the distractions and necessities of his medical curriculum of which neurology is only one of the constituent parts. From the standpoint of the advanced student or practitioner the volume contains a mine of most valuable information gathered from many sources and made readily available but for this type of reader, the presentation is often entirely too dogmatic and conclusions are proposed which will not be accepted by the majority of experienced workers in this field.

In presenting various syndromes of the brain-stem use is made of individuals presenting neoplasms. This is notoriously unsafe since neoplasms of the brain-stem usually involve structures at a distance from their site and also in many instances fail to involve structures within their compass, for example—Benedict's tegmental mesencephalic syndrome is described as presenting pyramidal tract symptoms which is contrary to the strict interpretation of the syndrome and the generally accepted restriction of its localisation to the tegmentum of the mesencephalon. It is fairly generally accepted that vascular lesions produce much more satisfactory brain stem syndromes than those occasioned by the involvement of the brain-stem by tumors. In the presentation of the tumors of the hypophysis and the neighboring structures no mention is made of the results of pressure upon the brain-stem or the structures contained within the cavernous sinus. In view of the extreme detail devoted to the consideration of other regions, these omissions make for a certain degree of unevenness in the treatment of the various syndromes presented.

The chapter on the neoplasms arising in and around the floor of the third ventricle and the associated structures are perhaps the most satisfactory in the volume. The treatment of the histological features of the various tumors discussed is as would be expected, most thorough and painstaking. This feature of the volume makes the book extremely valuable to neuropathologists, neurologists, and neurological surgeons.

The chapter on encephalic tumors in general contains a great deal of material of great value to the clinical neurologist and neurological surgeon. It is, however again marred by many colloquial expressions and forms of speech and a number of the illus-

trations are but little more than black-board sketches, copies of which they undoubtedly are. Neither of these features contributes to a pleasant impression. The general distinctions and differences between the various neoplasms, the classifications and detailed descriptions are brief, distinct, clear and very useful.

Chapter 18 deals with the general problems of diagnosis between brain tumor and other organic conditions of the brain. The author considers migraine and recurrent headache and the numerous processes which undermine and finally overthrow the cognitive faculties of the mind, such as repeated small cerebral insults, senile dementia, presenile dementia, cerebral arteriosclerosis, general paralysis, and cerebral syphilis. The question of generalized and focal seizures is considered in detail since these irritative manifestations are so commonly indications of the presence of a neoplasm within the brain substance, and a number of case studies are used to exemplify the problem as it is approached by the physician. Recurrent vomiting and failure of vision are examined in relation to their occurrence with other cerebral morbid processes. The author rightly emphasizes the importance of an intimate acquaintance with the ophthalmoscope and the structures made visible by its use. The commonly seen alterations in the fundus in optic neuritis, papilloedema, choked disc, nephritic hypertension and arteriosclerotic conditions are well described and the difficult distinction between optic neuritis and papilloedema made as clear as it can be. The appearance of primary and secondary optic atrophy are succinctly presented. The writer divides the neurological symptoms into three groups—(1) focal, (2) neighborhood and (3) distant, emphasizing the importance of the chronological order of development of symptoms but draws attention to the fact that neoplasms which arise in relatively silent areas may be characterized by distant symptoms arising either from an increase in general intracranial pressure or by compression of arteries supplying relatively distant areas, before focal symptoms appear. The author emphasizes the relief often occasioned by the injection of hypertonic solutions, decompression, etc. which may accomplish such an improvement in the patient's general condition that a satisfactory localizing diagnosis may be made at the neurologist's lecture.

The author correctly states that "ventriculography should be resorted to only when necessary" and deprecates the belief that this method can supersede careful neurological diagnosis. He correctly emphasizes the fact that "ventriculography does not make a diagnosis of tumor but only of distortion or displacement of the ventricles."

In the chapter on differential diagnosis between neoplasms and other pathological conditions, the writer rightly emphasizes that the diagnosis of tumor is made with the sum total of one's knowledge of neurology. The author limits his consideration in this chapter to the more usual conditions which may be confused with intracranial neoplasms and in general the presentation is adequate and helpful. The

important differentiation between neoplasm, tuberculoma, gumma, abscess, both acute and chronic, parasitic disease, chronic subdural hematomas and aneurysms are satisfactorily considered, but the space devoted to the consideration of the encephalopathies and encephalopathies is rather meager. One can perhaps wish that much of the space devoted to anatomy, physiology and disputed points in regard to symptomatology could have been devoted to a more extensive consideration of differential diagnosis. It would seem that such a course would be of greater value to the student and to the neurologist.

The chapter on the treatment of intracranial tumors and its results is relatively short but admirable—not much space is given to the technical details of the optimum incision and approach but the general principles of intracranial technique and the post-operative management of the patient are excellently presented. The author stresses the importance of the proper handling of the three most feared postoperative complications—hemorrhage, shock, and respiratory paralysis, explaining clearly and describing definitely the procedures to be followed. The surgical principles are presented simply and convincingly.

In preparing this volume one can well admire the Herculean task which the author has attempted and in general the admirable results which he has obtained. The balance of the book, when viewed from the standpoint established by the author of bringing forth a volume which will be read by the medical undergraduate, may however be criticized. In many instances material which can adequately be grasped only by one already highly trained in neurology has been poured forth with a prodigal hand before an audience which has neither the background nor the perspective to appreciate it. Such prodigality may lead to too early satiety and many of the innumerable excellencies of the volume will therefore fail to reach the author's consuming public.

In the form of the volume and the manner of presentation one can perhaps differ and still remain friends as to what is most desirable, but in the reviewer's mind there lurks the suspicion that the too easy method of combining groups of lectures into a book has been followed and that the very necessary drudgery of manuscript and proof reading and re-reading has been begrudged by the author to the very evident injury of the style and dignity of presentation. The decision as to the proper amount of nectar and ambrosia to be set before the undergraduate is always a difficult decision to make, but in general it is better to whet the appetite for more than to fill the rest with a superfluity of viands.

There is so much in the volume to make it a mine of information and so invaluable a recourse for the student, neurologist, neuropathologist, and neurological surgeon, that the reviewer has taken the liberty of going perhaps more into detail than he should, with the purpose that future editions may appear without many details which militate against the self-evident value and usefulness of the volume.

HENRY ALGER RILEY.

SURGERY, GYNECOLOGY AND OBSTETRICS

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STUDIES IN BONE SARCOMA

I MALIGNANT OSTEOSTEOMATOSA AS EVIDENCE FOR THE EXISTENCE OF TRUE OSTEOSTEOSTEOMATOSA

ALEXANDER BRUNTSCHWIG M.D., AND PAUL H. HARMON Ph.D. M.D. CHICAGO

From the Department of Surgery The University of Chicago

IN A review of the literature on the histopathology and histogenesis of osteogenic sarcoma, it is found that almost all of the attention is paid to the primary tumor and that little consideration is given to metastases. In textbooks of pathology mention is sometimes made of the fact that metastases from some of these neoplasms may contain bone. There has also been little attempt to correlate the histopathology of the primary growth with that of the metastases in regard to new bone formation. A study of the cases of osteogenic sarcoma in the Laboratories of Surgical Pathology of the University of Chicago and of those in the Bone Sarcoma Registry of the American College of Surgeons would indicate that bone producing metastases from osteogenic sarcomata exhibiting much new bone formation in the primary growth occurs much more frequently than is generally recorded. In fact it is possible that all true osteogenic sarcomata produce ossifying metastases. Furthermore a consideration of these neoplasms that produce ossifying metastases throws considerable light on the nature of osteogenesis a process about which there is still considerable controversy.

The classical notion of the existence of osteoblasts or cells the principle function of which is bone formation has been seriously questioned by certain authors (Von Korff,

Mummery Spuler Hansen Nageotte Leriche and Policard Murray Grieg). According to Murray Bone is to be regarded in this conception not as a result of specific cell activity but as a biochemical phenomenon independent of such direct cell participation. Bone production in the adult animal may be regarded as the deposition of calcium compounds in growing granulation tissue incident to the biochemical status of the part. Leriche and Policard state "The osseous transformation of connective tissue is a phenomenon independent of all cellular action. It is an interstitial and humoral process."

Experimental work on osteogenesis has afforded an extensive literature and yielded important information but no crucial experiments are recorded in which bone formation has been conclusively demonstrated to be the result of direct cell activity. The conception of the osteoblast as a specific bone forming cell is the result of morphological studies of the early days of microscopic anatomy (H. Müller, Waldeyer Gegenbaur etc.) For example in intramembranous ossification the rounded or polyhedral cells lining newly forming bony trabeculae and being obviously included within the bone presented a picture that took little imagination to ascribe bone forming properties to these cells. Leriche and Policard reviewed the entire field of osteogenesis, interpreting the

whole process as a humoral one and not associated with activities of a specific cell the osteoblast. According to them, bone formation will occur wherever there are sufficient collagenic bundles (upon which calcium may be precipitated) lymphodema, and supersaturation of the tissue fluids with calcium. Their interpretations are likewise based almost entirely on morphological studies. It must be admitted that there is as much logic to the evidence presented by these latter authors as there is to the older conception of the osteoblasts. If there were no definite proof that such cells exist. However most of those regarding the humoral conception of bone formation as the correct one have disregarded the existence of those sarcomata arising in bone and characterized by extensive bone production in the primary growth with similar bone production in metastases no matter in what tissues these develop.

Many malignant tumors bear considerable resemblance to the normal structures in which they arise. For example, a carcinoma arising from a bile duct reproduces roughly

atypical bile ducts in the primary growth and metastases epidermoid carcinomata, reproduce atypical skin etc. Likewise, in the presence of malignant tumors arising in bone with atypical bone production in the primary growth and in the metastases, no other explanation is possible but that there is a malignant degeneration of a bone forming cell, an osteoblast,—a malignant degeneration in which the bone forming properties are retained just as the keratohyaline forming properties are retained in certain squamous cell carcinomata of the skin (pearl formation) or collagen forming properties are retained in sarcomata arising from ordinary fibroblasts.

The following are two instances of such bone sarcomata from the collection of Dr Phemister and have already been briefly cited by him in the literature

CASE 1. M. G. aged 15 years. The primary tumor was in the upper portion of the tibia forming a spherical mass protruding posteriorly. Figure 1 is a roentgenogram of a gross longitudinal section of the specimen showing irregular bone formation throughout the growth (mottled shadows). There is new bone formation within the tibia as well as out in the



Fig. Case 1. Roentgenogram of gross longitudinal section of upper portion of tibia showing irregular distribution of newly formed bone in tumor both within and outside the shaft.



Fig. Case 1. Roentgenogram of pelvis and lumbar spine showing dense shadows in the inguinal lymph nodes which are due to bone producing metastases from a tumor of the tibia.

extracortical portion of the tumor. Practically no destruction of the tibia is seen. Figures 2 and 3 are roentgenograms showing dense shadows of ossified metastases in the inguinal lymph nodes and lungs, respectively.

Microscopic examination of sections from the primary tumor and metastases reveals a neoplasm composed of rounded and polyhedral cells with moderate amount of cytoplasm and oval nuclei containing finely stippled chromatin. There is every where an inherent tendency to bone formation. In large areas there are anastomosing osseous bands between which there are collections of tumor cells. In places these bands widen into trabeculae of mature bone (Fig. 4).

CASE 2. T. V. I., aged 38 years. Bone Sarcoma Registry No. 335. The primary tumor involved the upper portion of the humerus where it presented an oval swelling. Figure 5, a roentgenogram of the amputated specimen, shows new bone throughout the tumor in the form of spicules radiating at a 45 degree angle from the surface of the shaft. In the upper mesial portion is a large oval area of tumor devoid of bone, this zone being composed of cartilage. Figure 6, a roentgenogram of the chest taken some time before death, shows extensive metastases casting a dense shadow (bone).

Subsequent to amputation other metastases developed in the skin of the face and scalp and in the left pectoral muscles. Figure 7 is a roentgenogram of a skin metastasis in the facial region showing

ossification. At autopsy one lung was found to be surrounded by a heavy shell of bone (pleural metastases) and extensive bony metastases were present in the other.

Histological examination of that part of the primary tumor outside the shaft of the humerus shows it to consist of irregular anastomosing trabeculae of bone, the spaces between which being filled by large rounded or spindle-shaped tumor cells with one or sometimes several nuclei. In areas in which bony trabeculae are being formed, tumor cells are seen to be included to form the bone cells. In some fields irregular masses of neo-formed cartilage are present. The neoplasm is nevertheless essentially an osteogenic sarcoma. Sections from the pulmonary metastases afford identical pictures to those seen in the primary growth (Fig. 8). Bone is likewise present in a section from the skin metastasis (Fig. 9). Another metastasis in the muscles of the left side of the neck is composed of spindle cells arranged in a whorl about a central cartilaginous area.

A case of osteogenic sarcoma in a mouse with an ossifying metastasis is recorded from the colony of Miss Blaxds Slye. Sections of a large tumor of the femur show it to be composed of narrow irregular anastomosing bands of tumor osteoid tissue surrounding areas of anastomosing bony trabeculae (Fig. 10). In the spaces between these trabeculae are closely packed, small rounded and polyhedral cells with hyperchromatic nuclei and little cytoplasm. A metastatic nodule in the liver is also composed essentially of osteoid tissue and bony trabeculae with tumor cells packed in the spaces between the trabeculae (Fig. 11).

Grieg in a recently published monograph on "Surgical Pathology of Bone" states "A metastasis from a sarcoma reproduces its original cells more or less accurately but it never produces bone unless its vascularity



Fig. 3. Case 1. Roentgenogram of chest showing dense shadows cast by bone-producing metastases in lungs from osteogenic sarcoma in tibia.



Fig. 4. Case 1. Photomicrograph of primary osteogenic sarcoma in tibia showing A. osseous bands between nests of tumor cells B. C. An island of mature bone.



F Case 1. Roentgenogram of specimen showing
ost osteogenic sarcoma, primary in upper half of femur.
Box shows the tumor is seen as spicules radiating at 45
degrees angle from surface of cortex. Note rarefaction in
lower half and large area, A, containing almost no bone (car-
tilage).

taps some supply of calcium whether it be a physiological reservoir such as bone or a more heterotopic collection of calcium previously accumulated. If the cells of a sarcoma were bone forming the metastases would certainly be osseous in all. This they certainly are not. It is significant that a professional pathologist even of wide experience with whom I have discussed the matter can not recall from his own experience a single case in which even one metastasis from a periosteal or endosteal osteogenic sarcoma contained bone. The fallacy of the frequency of its occurrence seems to be promoted from text book to textbook on the strength of some well nigh unique specimen preserved on account of its rarity. When, on rare occasions, a metastasis shows apart from bone a bony structure, it is significant that that metastasis is

situated in a site where calcification is known commonly to occur.

This author is quoted in detail since, believing in the correctness of the humoral conception of bone formation he attempts an explanation for bone producing metastases of bone sarcoma, at the same time inferring that such sarcomata do not exist. However his views are not consistent with evidence at hand. In the first place, cases of osteogenic sarcoma with bone production in the metastases are by no means 'well nigh unique.' In addition to the animal and human cases described a review of the literature reveals additional cases. LeCount, in 1909 collected a number of instances of osteogenic sarcomata with bone producing metastases these are included in the series in Table I.

It is not possible to obtain a definite conception of the incidence of ossifying metastases from osteogenic sarcoma, due to the fact that in the great majority of cases on record there is incomplete data concerning the roentgenographic and histological appearance of the metastases. It is unusual to find a detailed autopsy report from a case of osteogenic sarcoma that exhibited extensive bone formation in the primary growth.

Osteoblastic properties on the part of the tumor cells themselves may be strongly suggested by extensive atypical osteoid tissue and bone formation throughout the primary neoplasm. But final proof of such properties lies in their ability to produce bone in any tissue they may develop that is in the ability of the neoplasm to produce ossifying metastases.

In those osteogenic sarcomata producing ossifying metastases, the presence of cartilage is not an uncommon finding and may well be interpreted as an irregular variation of neoplastic bone forming cells. Malignant degeneration of chondroblasts, on the other hand gives rise to chondrosarcoma, tumors that constitute a separate class, having characteristic roentgenographic and histological structure as recently pointed out by Phemister. Limited calcification and bone formation are noted in these neoplasms, both in the primary growth and in the metastases. This ossification is an expression of maturation of certain portions of the neoplasm, since in



Fig. 6. Case 2. Roentgenogram of chest after inter-thoraco-humoral amputation of left arm, showing dense shadows of bone producing metastases in lungs and pleura.

the general economy of the body the greater part of all cartilage formed during development is finally substituted by bone.

The conception that the extensive bone formation present in the metastases of the tumors described above is due to the tapping of a "physiological reservoir" of calcium as stated by Gneg is untenable. In the first place, what little calcium and bone may be present in healed tuberculous processes of the lungs cannot possibly be sufficient to furnish enough calcium salts for the extensive bone formation present in the pulmonary metastases of some of these tumors. Furthermore, in those cases in which bone is produced in metastases in the liver inguinal lymph



Fig. 7. Case 2. Roentgenogram of excised cutaneous bone forming metastasis in skin of face from osteogenic sarcoma of humerus.

nodes, skin and pericardium, it would be far fetched to suppose that there existed calcareous deposits in these locations prior to the development of metastases so that the extensive ossification present in them is due to the "reworking" of this calcium into bone by the malignant metastatic cells. Again were bone formation in osteogenic sarcoma simply due to malignant mesoblastic cells growing in close proximity to a supply of calcium it should be an easy matter to produce experimentally osteogenic sarcoma by causing a transplantable fibrosarcoma (embryonic type) to grow about a deposit of calcium in the tissues.

Experiments of this type have been performed and will be discussed in a subsequent paper. Suffice to state here that sarcomata containing bone, similar to the ossifying metastases in the cases described were not produced.



Fig. 8. Case 2. Photomicrograph of metastatic pulmonary nodule showing bone of tumor cell origin, some of which are included within the bone to form bone cells. $\times 110$.



Fig. 9. Case 2. Photomicrograph of cutaneous metastasis showing the formation of bone about hair follicle. $\times 110$.

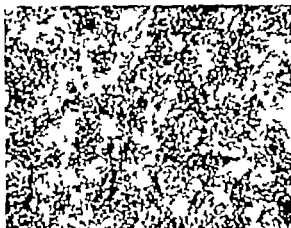


Fig. 10. Osteogenic sarcoma of femur in white mouse showing anastomosing trabeculae of tumor osteoid tissue and bone, separated by small tumor cells.

To repeat the evidence afforded by the existence of the type of bone sarcoma here again described in which there is much bone formation in the primary growth with similar extensive ossification in the metastases, no matter in which tissues they develop is practically conclusive for the existence of the osteoblast or bone forming cell since these neoplasms represent malignant degenerations of these cells. No other explanation can account for them.

In pointing out this evidence for the existence of the osteoblast, the authors do not wish to deny that there are reasons for believing that a local or general increase in calcium may be sufficient to stimulate osteogenesis. After all, the osteoblast is a specialized form of the fibroblast and there is ample evidence to indicate that almost any fibroblast may be stimulated to form bone. For as stated by Nicholson Bone has been found in and around areas of necrosis and calcification in nearly every organ and cubic inch of the body. It is always produced by the cells of the areolar tissue that have proliferated to form a barrier of granulation tissue around the calcified foreign body. It is quite possible that calcium when present in sufficient quantity for sufficient length of time, and in the necessary chemical combinations is capable of bringing forth osteogenic properties in mesoblastic cells, properties that under normal conditions are dormant.



Fig. 11. Photomicrograph of periphery of metastatic osteogenic nodule in liver of white mouse. A. Tumor cells exhibiting osteoid tissue and bone. B. Liver $\times 100$.

So much has already been written concerning the terminology to be used in osteosarcoma that any further comment in this direction is done only with the greatest hesitation. The term 'malignant osteoblastoma' has been applied to the tumors mentioned above because it expresses the true nature of the neoplasm. In the past these tumors have been included under the general heading of osteogenic sarcoma. On the other hand, they constitute such a distinct group in the large general class of sarcomata arising in bone that they are entitled to a special consideration. Yet, this term "malignant osteoblastoma" is not a new one. It has been used in the German literature (4, 13) to designate a rather rare type of neoplasm arising in connection with bone, and composed of large rounded cells lining short trabeculae of newly formed bone or simply forming soft tissue masses. These cells appeared very much like the cells regarded as osteoblasts seen in normal osteogenesis, hence the use of the term "osteoblastoma." Such a designation however, appears to be unjustified since the very few original reports contain insufficient evidence of osteoblastic activities on the part of the tumor cells, and the histological nature of metastases from these tumors is not described.

In closing it may be stated that a sarcoma in growing from the bone in which it arises may elevate the periosteum ahead of it causing this membrane to form new non-tumor

TABLE I

| Author | Date | Site of original tumor | Location of bone forming metastases |
|--|------|------------------------|---|
| Baile | 793 | Around the knee | Lungs |
| Hilber | 855 | Femur | Lungs, both subpleurally and deep, omentum, and diaphragm |
| Wilks | 857 | Lower third of femur | Mass involving sternum and mediastinal glands |
| | | Femur | Lungs |
| | | Lower third of femur | Lungs and mediastinal lymph glands |
| | | Femur | Lungs |
| | | Arm (humerus?) | Lungs |
| Virchow (56) | 858 | Femur | Lungs |
| Virchow (57) | 864 | Upper third of humerus | Lungs |
| | | Femur | Inguinal and pelvic lymph glands, lungs, and pleura |
| Schöten | 1877 | Lower third of femur | Lungs, pleura, pericardium, dura mater |
| Alba | 1878 | Upper third of humerus | Pleura, lungs, thae, and paravertebral glands |
| Oberst | 1880 | Lower third of femur | Lungs |
| Durham | 1883 | Upper third of femur | Calvarium, temporal bone, opposite tibia, iliac glands, lungs and heart |
| Went | 1883 | Left knee region | Lungs and pericardium |
| Pitts | 1886 | Radius | Epitrochlear and axillary glands, lungs |
| Power | 1889 | Tibia | Lungs, pleura, clavicle, and ribs |
| Haktoen | 1893 | Upper third of tibia | Heart and lungs |
| Borst | 902 | Femur | Lungs |
| Jenckel | 903 | Lower femur | Lungs, pleura, and pericardium, inguinal glands, neck glands, tonsil |
| | | Lower femur | Lungs and pericardium |
| Felstmaul | 1904 | Middle third of femur | Destructive metastases to sacrum and lumbodorsal vertebrae Ossifying metastases to lungs |
| Ribbert | 914 | Not stated | Lungs |
| Mills | 1924 | Pelvis | Lungs |
| Kolodny | 927 | Not stated | Lungs |
| | | Not stated | Lungs |
| | | Not stated | Skin |
| Clark | 938 | Femur | Lungs |
| Geschlchter and Copeland | 940 | Lower third of tibia | Lungs |
| Geschlchter | 95 | Not stated | Lungs |
| Jaffe | 953 | Extremities (5 cases) | Lungs and pleura |
| Bone Sarcoma Registry American College of Surgeons | | | |
| Case 784 | | Lower femur | Röntgenological evidence only of ossifying pulmonary metastases |
| Case 857 | | Upper femur | Röntgenological evidence only of ossifying pulmonary metastases |
| Case 954 | | Lower femur | Röntgenological evidence only of ossifying pulmonary metastases |
| Case 930 | | Upper tibia | Röntgenological evidence only of ossifying pulmonary metastases |
| Case 914 | | Lower femur | Histological preparations show ossifying pulmonary metastases |

bone This constitutes another factor in new bone formation in osteogenic sarcoma. Such new bone is obviously not due to the osteogenic activity of the neoplastic cells and were this the only source of new bone in an osteogenic sarcoma the metastases would not ossify. This phase of the problem will be discussed in a subsequent report of our Studies in Bone Sarcoma."

CONCLUSIONS

1 Two cases, and one instance in an animal of bone sarcoma are reported and 37 collected from the literature in which there was ossification of both the primary tumor and of the metastases in various tissues

2 No explanation can account for these tumors but that they are malignant degenerations of osteoblasts or bone forming cells

Thus they afford conclusive evidence for the existence of osteoblasts

3 The term malignant osteoblastoma is suggested for this group of ossifying bone sarcomata which should be considered a distinct subdivision of the general group of sarcomata arising in bone. Further study may reveal that all true osteogenic sarcomata are malignant osteoblastomata.

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THE GINGIVÆ DURING PREGNANCY

AN EXPERIMENTAL STUDY AND A HISTOPATHOLOGICAL INTERPRETATION¹

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THE following study reported here in a preliminary way, and begun about a year ago, was prompted by the frequency of gingival changes observed in pregnant women. The source of our clinical material for observation was Sloane Hospital, whose patients are routinely referred to "Dentistry for mouth examination and treatment" and the School of Dental and Oral Surgery, Columbia University.

"Pregnancy gingivitis" may assume four forms. These may or may not be progressive stages of the same underlying factors.

The first form is characterized by bleeding of the gums when traumatized by toothbrush, food, etc. If there has been a pre-existing tendency toward bleeding, this tendency is often exaggerated during pregnancy.

In the next form, usually only the free gum margin is involved; it takes on the color and appearance of a raspberry. The highly inflamed tissue bleeds easily on being probed. While it may appear in any part of the mouth, it is more commonly found in the region of the anterior teeth. This form of "pregnancy gingivitis" is designated "raspberry red gums."

The third form is a generalized hypertrophy of the tissue. Here the gums are swollen, assume an old rose color, and if irritation is present, the borders become a bright red. The gum papillae become hypertrophic or grow out from the under surface of the free gum margin to cover a large portion of the tooth, pushing the normal gum back and forming a straight, blanched line immediately above the proliferative tissue. This type of gingivitis is usually confined to one section of the mouth, although it may involve more than one area.

Irritants such as food impactions, calculus, soft deposits, and lack of function on one side, are often found on or under the free gum margin. Sometimes no irritants are apparent. The gums bleed easily on being probed, but are seldom if ever painful. This form is called "hypertrophic gingivitis of pregnancy."

Fourth is the so-called "pregnancy tumor," which is usually confined to a single growth, springing up at any point in the mouth. At the beginning it appears to be an overgrown gum papilla. It may be sessile or pedunculated. After it has attained considerable growth, it resembles an epulis, varying in size from about 1 to 2 centimeters in diameter, sometimes larger. In color, it is for the most part cyanotic, but bright red on the border. Many times it interferes with mastication and the trauma to which it is subjected produces an area of grayish necrosis on parts of the surface. It may begin early in pregnancy, usually grows rapidly, and bleeds easily.

Here also gingival irritants may be present. The growth starts during pregnancy and for this reason is known as "pregnancy tumor." It differs from the ordinary epulis in that it may either disappear entirely or diminish greatly in size after parturition.

All forms of "pregnancy gingivitis," if not properly treated, are likely to recur with subsequent pregnancies. Moreover, "pregnancy gingivitis" may or may not be accompanied by a subacute or chronic Vincent's infection, suppurative periodontodasia, or the presence of fungi and bacteria in the tissue.

Since the patients are seen for the most part after the first or second month of pregnancy, we cannot determine exactly the onset of the gingivitis. The only accurate datum that we

¹ Preliminary report presented in abstract form at a meeting of the Faculty of the School of Dental and Oral Surgery, March 15, 1933.



Fig. 1. An enlarged photograph of the gingivae of Mrs. J. B. (Case 5 of Table I). Note the hypertrophic papillae covering in part each tooth, which are old reses in color. The largest of these, A, has grown to the size of a so-called pregnancy tumor and has the characteristic bright red border (seen as black in this print).

can obtain is the time when bleeding of the gums was first noticed.

Figure 1 is a photograph of the gingivae of Mrs. J. B. during the fifth month of pregnancy and is illustrative of some of the changes described above.

This affection is not limited to pregnant women. It occurs also in non-pregnant women, in men very frequently in boys and girls at the time of puberty and in women during the menstrual period. A hypertrophic gingivitis in a non pregnant woman may easily be carried over into pregnancy. Hence we are not justified in unqualifiedly diagnosing all such conditions as springing solely from the pregnant state.

But it is clearly to be seen—and may we emphasize this point—that the great majority of these gingival changes occur at times usually associated with hormone change—during pregnancy, menstruation and puberty. This observation led us to experimentation with laboratory animals by the injection of various hormones in an attempt to determine whether or not such hormones play an etiological rôle.

Our study may be divided into two parts, clinical and experimental.

1. *Clinical.* We made routine examination of the mouths of 416 pregnant women and recorded the presence or absence of preg-



Fig. 2. A low power view of one of the papillae of Mrs. J. B. (shown in Figure 1). Here the corneous layer A is present, and the epithelial pegs, B, show a marked tendency toward downgrowth, but are blunt and do not split frequently.

nancy gingivitis. We noted the type of affection present, the size and extent of the involvement of the gingivae and the presence or absence of sources of irritation. In some mouths where not all the papillae were involved macroscopically we also studied the grossly uninvolved papillae, obtaining biopsies of both classes. Microscopical findings of these will be reported later.

Further observation included mouth hygiene, tendency to easy bleeding of the gums on being traumatized, and spontaneous bleeding. Then we attempted to ascertain whether hemorrhage due to traumatization occurred only after pregnancy or if it was already present before pregnancy, was it increased with the onset of the term.

Each patient was given a toothbrush for actual demonstration of the method usually used in brushing her teeth. We tried to learn if use of a new toothbrush could have caused the increased bleeding or if some change in the manner of brushing might be responsible.

Of the 416 pregnant women examined 158 or 37.9 per cent had some form of observable pregnancy gingivitis. Of the latter number 111 or 70.2 per cent, had the hypertrophic type 65 or 41.1 per cent, showed raspberry red gums and 3 or 1.8 per cent pregnancy tumor. Included in this classification are 21 cases, or 13.2 per cent, which disclosed combinations of the foregoing forms.



Fig. 3. A low power of one of the grossly involved papillae of Mrs. E. B. (Case 22 in Table I). Here, the corneous layer is almost entirely absent, the stratum granulosum is deep and the epithelial pegs are pointed and split frequently. Hydropic change, *A*, is seen throughout the entire epithelium.



Fig. 4. A low power of a papilla normal on gross inspection (Mrs. E. B. Case 22 in Table I). Note similarity to Figure 3. The corneous layer here, as in Figure 3, is almost entirely absent, while the stratum granulosum is deep. The epithelial pegs are deep and pointed and split frequently. Hydropic change is not as marked as in Figure 3.

Location of "pregnancy gingivitis" was as follows: anterior area, 114; bicuspid area 98; molar area, 80; molar and bicuspid areas combined 16; bicuspid and anterior areas combined 12; molar and anterior areas combined 6; molar anterior and bicuspid areas combined, 50; incomplete histories 3.

Hemorrhage on traumatization was evident in 295, or 70.9 per cent, of the entire group. Among these 7, or 0.2 per cent, also had spontaneous hemorrhage. In 171 cases or 57.9 per cent, hemorrhage was noted before pregnancy with the tendency in most instances, toward accentuation during the term. In 115 cases, or 38.9 per cent, hemorrhage started after the onset of pregnancy. Of these 115 patients 62 presented "pregnancy gingivitis" while of the 62 irritants in relation to pregnancy gingivitis were apparent in 53. In 9 or 0.3 per cent histories were incomplete.

Histories as to the use of a new toothbrush being associated with the onset of hemorrhage were essentially negative. In all there were 44 patients who acquired new toothbrushes within a few months of the time of examination. Of these, 6 patients related the acquisition of new brushes to the onset of hemorrhage.

Irritation was found to be present in relation to "pregnancy gingivitis" in 119 cases, or 75.3 per cent of the 158 mouths thus affected. In 39 or 24.7 per cent there were no demonstrable irritants in relation to the affected gingivæ. Some form of irritation with or without relation to "pregnancy gingivitis" existed in 400.96 per cent, cases. Sixteen 3.9 per cent, mouths were free from irritants.



Fig. 5. A low power of one of the involved papillae of monkey No. 123. The epithelium is hyperplastic, with some tendency to downgrowth of the pegs.

TABLE I.—HISTOLOGICAL STUDY OF PREGNANCY GINGIVITIS

| | Case M | Name | Gross appearance of lesion | | | | | Stratum corneum | | Stratum granulosum | | Stratum paracorneum | | Mucosa | Connective tissue | Submucosa | | | |
|------------|--------|-------|----------------------------|---------------|-------------|-------|----------|-----------------|-------------------|--------------------|-------------------|---------------------|----------|--------|-------------------|-----------|-----------|------------------|------------|
| | | | Type | | | | | Width | Hydrolytic change | Width | Hydrolytic change | Disruption | Spitting | Pores | | | Lymphatic | Discharge of pus | Hemorrhage |
| | | | Hydrolytic | Raspberry red | Physiologic | Ulcer | Location | | | | | | | | | | | | |
| 4th month | | A H | P | O | O | + | Ant | ++ | ± | ± | + | + | - | | | | + | ? | ? |
| | | G D | O | P | O | ± | Rt | ++ | + | ± | - | + | - | | | + | ++ | + | + |
| 5th month | 2 | V H | P | P | O | + | Ant | + | + | + | + | + | - | + | + | + | ++ | + | ± |
| | | A K | P | O | O | + | Gen | ++ | ± | ± | - | + | - | | | ++ | ++ | + | ± |
| 6th month | 5 | J B | P | O | P | ++ | Gen | ++ | ± | ± | + | ++ | ± | | | ? | + | ± | + |
| | 6 | E B | P | O | O | + | Gen | - | - | + | ± | + | ± | ++ | | | ± | ± | |
| 7th month | 7 | W I | P | O | O | ± | Ant | + | - | ± | ± | + | + | ± | | | + | + | ± |
| | 8 | W L | P | O | O | + | Gen | ± | - | + | + | ± | ± | ± | | | ++ | + | + |
| 8th month | 9 | A O | O | O | P | + | Ant | + | - | ++ | + | + | ± | | | + | ++ | ± | + |
| | 10 | L Y | Normal appearing | | | | Post | - | | + | + | ++ | - | | | + | ++ | ± | ? |
| 9th month | | E Y | P | O | O | ± | Post | - | | + | + | ++ | - | | | + | ++ | ? | ± |
| | | M H | P | O | O | ± | Ant | - | | ± | ± | ++ | - | | | + | ++ | + | - |
| 10th month | | Y O | O | O | P | ++ | Ant | - | | ++ | ± | + | + | ± | | ++ | ++ | + | + |
| | | M B | P | O | O | ± | Gen | ± | - | ++ | + | + | + | | | ? | ? | ? | + |
| 11th month | | H G | Normal appearing | | | | Ant | + | - | + | + | + | + | | | ? | ++ | ? | ++ |
| | | H O | P | O | O | ± | Ant | + | - | + | + | + | + | ± | | ? | ++ | ± | |
| 12th month | 5 | S K | P | O | O | ± | Gen | - | | ++ | + | + | - | ± | ± | + | ++ | + | + |
| | 10 | C M | P | P | P | ± | Gen | - | | + | + | + | - | | | ± | +++ | + | + |
| 13th month | 7 | E M | P | O | O | + | Gen | - | | + | + | + | ± | ± | | ? | +++ | | + |
| | 8 | P O | P | O | O | + | Gen | ± | - | + | + | ++ | ± | | | + | +++ | + | + |
| 14th month | 9 | W P | P | O | O | | | - | | ++ | + | ++ | + | | | + | ++ | + | + |
| | 10 | M C M | P | P | O | + | Gen | - | | + | ++ | ++ | + | | | + | ++ | + | + |
| 15th month | (14) | P G | P | O | O | + | Gen | - | | ++ | ++ | ++ | ++ | | ++ | | ± | + | |
| | 15 (6) | E B | Normal appearing | | | | Post | - | | + | ++ | ++ | ++ | | | | ± | | |
| 16th month | (6) | E B | P | O | O | + | Gen | - | | ++ | ++ | ++ | ++ | | + | + | ± | | |

P—Present O—Absent Order of degree of change — ± + ++

Three hundred and twenty two 77.4 per cent women showed unhygienic mouths 23 5.5 per cent clean mouths of which 17 possessed irritants without relation to pregnancy gingivitis and of the 17 6 had pregnancy gingivitis.

Sixty-seven 16.1 per cent, had filthy mouths. History was incomplete in 4 instances 0.9 per cent. None of the women brushed her teeth correctly, although most of them claimed to use a toothbrush.

Marginal gingivitis was found to be present in the region of the buccal surface of the upper second molars and the lingual surface of the

lower second molars in 284 68.2 per cent of all the patients, while in 39, 9.3 per cent other marginal gingivitis in the molar regions were inflamed. Ninety nine, 23.7 per cent, showed marginal inflammation in the buccal regions. Marginal inflammation in the region of the anterior teeth was disclosed in 130 31.2 per cent cases.

Microscopical sections made from the biopsies were studied with the following objects in view (1) to determine whether or not a relationship existed between the mouth of pregnancy and microscopical findings (2) to determine whether or not a relationship ex-

isted between the form of the disease and microscopical findings, (3) to determine whether or not a relationship existed between extent of involvement and microscopical findings.

Accordingly changes in the stratum corneum, stratum granulosum and stratum germinativum of the epithelium were recorded, as well as changes in the submucosa. The details are shown in Table I.

It will be seen from Table I that with advance in pregnancy there is a gradual and definite decrease in the thickness of the *stratum corneum*. During the early months a slight increase in thickness is noticeable, but in the last months this layer disappears almost entirely. Some hydropic change of the corneum occurs early in the term.

The stratum granulosum is here shown to be generally hyperplastic, varying from a lesser change during the early stages to a more marked hyperplasia in the last months. However the changes in this stratum did not take place in as orderly a fashion as in the corneous layer. Hydropic change in the stratum granulosum was confined in the early months mostly to the superficial parts whereas in the last months the entire stratum was involved.

A definite tendency toward elongation of the epithelial pegs was found in the stratum germinativum. In the later months not only was this condition exaggerated but the pegs split more frequently and were generally pointed whereas earlier they had been blunt. Epithelial pearls appeared more often during the first half of pregnancy. Mitosis occurring both early and late in pregnancy was seen in only a few of the sections.

Figure 2 is a photomicrograph of a section of gum tissue taken during the fifth month of pregnancy while Figures 3 and 4 are photomicrographs of different papillæ taken from the same mouth during the ninth month. Figure 3 is of a gum papilla grossly affected with hypertrophic gingivitis while in Figure 4 the papilla appeared normal grossly.

In studying epithelial changes from the standpoint of the type, size, and extent of involved papillæ we were unable to record any relation between gross and microscopical

findings. Thus papillæ, grossly uninvolved (see Fig. 4) were microscopically similar to involved papillæ (see Fig. 3). Likewise, the degree or kind of involvement did not materially alter the order of change described as taking place early or late in pregnancy.

Inflammatory changes in varying degrees, resembling those commonly apparent in granulomata of the gums were prevalent in the submucosa in all cases. Pregnancy tumors and raspberry red gums evidenced the most intense changes. Ulcerations and hæmorrhage were present in some instances while bacteria and fungi were seen in about two-thirds of the cases.

2 Experimental The next phase of the study was carried on with rats. Gums of eight adult female rats were examined and found to be normal pink in color and firm in texture. Twelve of the females were paired with twelve males while the remaining six females were segregated as controls. When the rats became pregnant, they were again carefully studied. Some were examined for macroscopic changes of the gums during two or three successive pregnancies. Finally in order to make a comparative study of the effect of pregnancy and irritation on the gums a string ligature was tied around one tooth so placed that it came in contact with the gums.

Thirty young adult female rats, whose gums were found to be normal were ovariectomized. The animals were then placed in four separate cages. Group I comprised eight rats about whose upper incisor a string had been tied. They received subcutaneous injections of the following agents: theelin, antuitrin S and pregnancy urine (untreated). The eight rats in Group II received similar treatment, except that no artificial irritation of the gums was induced.

After studying one hormone, injections were discontinued for several days before a new agent was tested. All injections were subcutaneous. The vaginal smear test of Allen and Doisy was used to determine the effect of these hormones on the estrus cycle.

Cage III contained seven rats and served as control for Cage I, and all the rats had ligatures tied about a tooth to induce irritation. Cage IV was the control for Cage II.

TABLE II—GINGIVAL CHANGES IN THE IMMATURE MACACUS MONKEY AFTER INJECTION OF PREGNANCY URINE EXTRACT

| Number | Route of administration | Time | Days | Papilla | | | | | | | | Calculus | Dentitis | |
|--------|---------------------------------|------------|-------|---------|----------------------------------|------------|---------|--------------|-------------------------------|-------------------|---------------------------|----------|----------|--|
| | | | | Gum | Maxillary between upper incisors | Preincisor | Old gum | Alveola | New tissue on lateral incisor | Maxillary gingiva | Labial preincisor gingiva | | | |
| 38 M | Subcutaneous | B I | 36 | - | - | - | - | - | - | ± | | - | - | Pregnancy urine extract 4 days preceding this examination and then continued |
| | | 1st A I | 36 | + | - | - | - | - | - | + | | - | - | Lateral edges and cusps chalky |
| | | Peak | | | | | | | | | | | | |
| | | After peak | 47-48 | | | | | ++ | | | | | | |
| 39 F | Subcutaneous | B I | | | | | | | | | | | | |
| | | 1st A I | | - | - | - | - | - | - | - | | - | - | |
| | | Peak | 8-20 | + | - | - | - | - | - | + | | + | - | |
| | | After peak | 5 | - | - | - | - | ++ | - | | + | - | + | 2nd Papilla shortened and indurated |
| 40 F | Subcutaneous | B I | | | | | | | | | | | | |
| | | 1st A I | | - | - | - | - | - | - | + | | - | - | |
| | | Peak | 5 | + | + | - | + | - | - | + | | ± | + | |
| | | After peak | 8-20 | + | - | - | - | ++ | - | | + | - | + | Papilla (1st) smaller but very pale |
| 41 F | Subcutaneous | B I | | | | | | | | | | | | |
| | | 1st A I | 7 | ± | - | - | ± | - | - | ± | | - | - | |
| | | Peak | 10-15 | + | + | + | + | - | - | | + | - | - | Injected blood vessel (1st) |
| | | After peak | 2-20 | ± | - | - | - | - | - | ± | - | - | ++ | 1st (1st) Papilla cyanotic |
| 42 F | Subcutaneous | B I | | | | | | | | | | | | |
| | | 1st A I | | - | - | - | - | - | - | - | | + | + | |
| | | Peak | 16-45 | + | + | - | + | ++ (3rd day) | + | + | | - | - | |
| | | After peak | 22 | ± | - | - | + | - | + | | | | | |
| 43 M | Subcutaneous | B I | | - | - | - | - | - | - | | ± | | + | |
| | | 1st A I | | - | - | - | - | - | - | ± | | - | ± | |
| | | Peak | | - | - | - | - | - | - | ± | | - | - | No changes seen except antritis |
| | | After peak | | - | - | - | - | ++ | - | - | | - | - | |
| 44 F | Subcutaneous and intra-arterial | B I | | ± | - | - | - | - | - | ± | ± | - | - | 4 days after anterior pulmonary artery tract started |
| | | 1st A I | | + | - | - | - | - | - | + | ± | - | - | |
| | | Peak | 10- | + | - | - | + | - | + | ++ | + | - | + | |
| | | After peak | 20 | + | - | - | ± | ± | + | ± | - | - | + | 4 days after injection started back over antritis |
| 45 F | Subcutaneous | B I | 5 | - | - | - | - | - | - | - | - | + | ± | |
| | | 1st A I | 4-8 | - | - | - | - | - | - | - | - | + | ± | |
| | | Peak | 19-25 | + | + | + | + | ± | + | + | + | - | - | Pseudo papilla. Dilated vessel (1st) in alveolar and alveolar gingiva |
| | | After peak | 47-48 | ± | - | - | - | - | - | + | + | - | - | |

B I.—Before injection

1st A I.—First examination after injection.

Gum papilla between upper right lateral incisor and cuspid teeth

(1st) Upper left central and lateral incisor teeth

(2nd) Upper left first temporary molar

(3rd) Gum papilla between upper central incisor teeth and upper left central and lateral incisor teeth.

(4th) Upper left cuspid and first temporary molar

Throughout the entire experiment, we observed the gums for macroscopic changes. At varying intervals, we took biopsies of the gums of the rats in each of the cages.

Thus far, our findings in the rat are for the most part inconclusive. We noted no gross changes in the gums. On the other hand, microscopical examination showed some epithelial changes bearing a resemblance to the changes in the vagina of the rat reported by others studying the sex hormones. However, these changes are so slight that we are unable at this time, to draw conclusions.

The next series of experiments was on the young immature *Macacus rhesus* monkey. We were fortunate enough to learn that Dr Earl T. Engle was using these animals for a study of the effects of the various sex hormones on the organs of reproduction. With his kind permission we were able to observe the gums of the monkeys during the course of his experiments.

Of the eight monkeys studied six were females of which one was ovariectomized. Of the two males, one was castrated. All eight animals were injected with an extract of pregnancy urine. The urine, before being injected was precipitated with alcohol, ether extracted and concentrated, according to a modification of Zondek's method.

Biopsies were obtained on two monkeys before injections were begun, on six after the animals were killed, two died, making biopsy unattainable.

Details of this phase of the work are listed in Table II.

It will be noted that we examined the mouths of four of the monkeys before starting pregnancy urine injections, finding three essentially negative. The fourth monkey No. 118 had been receiving anterior pituitary extract for 4 days before we saw her and some of the anterior gum papillæ were slightly oedematous before the pregnancy urine extract was given. All the six females observed showed definite gross changes of the gums as the injections continued. The papillæ became oedematous and enlarged in all, but were especially evident in four. In five these enlarged papillæ subsequently took on the old rose color characteristic of human "pregnancy gingivitis."

Proliferative changes of the gums occurred in two monkeys. Non-traumatic hæmorrhage was observed in three of the animals. Marginal gingivitis, probably arising from retained food and débris, was present in all eight animals.

Changes in the gums reached the highest point in their development generally between 10 to 20 days after the daily injections of pregnancy urine extract were begun. After reaching the peak the changes receded. The enlarged papillæ gradually grew smaller and the color fainter the gums assuming a decidedly anæmic appearance in most of the animals.

Microscopical study of the foregoing changes in the monkey are at this writing incomplete. Such microscopical slides as we have studied show slight hyperplastic changes of the epithelium and some inflammatory cells in the submucosa. In one monkey No. 123 whose reaction was not manifest in time for inclusion in the above chart there was definite hyperplasia of the epithelium *without* inflammatory changes in the submucosa. This monkey showed gross changes similar to those already enumerated. The biopsy was taken approximately 3 weeks after the peak of the changes was noted. A photomicrograph of a section is shown in Figure 5.

DISCUSSION BY DR. STOUT

My connection with this investigation by Drs. Ziskin and Blackberg has been an attempt to evaluate the histological changes in the gums of the rats, monkeys and pregnant women and I shall confine my remarks to that phase of the work. The study was hampered by the facts that (1) there is great variation in gum epithelium in different individuals, in various papillæ in the same individual and in different parts of each papillæ; (2) that the majority of the papillæ show evidences of inflammation and this is usually associated with epithelial hyperplasia; (3) that the microscopic changes are relatively slight; and (4) the individual case could not be controlled because it was impossible to remove a papilla for study and still have it left for further changes to occur. Therefore it was necessary to compare different individuals or different

papillæ from the same individual, which is valuable only if the changes observed are marked and relatively constant.

In the gums of the pregnant women it seems to me that Drs. Zukin and Blackberg are justified when they say that the stratum corneum becomes progressively thinner as pregnancy advances from the fourth to the ninth month and that the strata mucosa and germinativa become thicker and more ordematous, and the epithelial pegs extend deeper into the submucosa. These changes occur on the anterior part of the papilla toward its apex. Variations occur due no doubt to the degree of inflammation and infection which is present in every case but allowing for this there seems to be a definite trend in the whole group.

The observations on the monkeys are fewer but they seem to confirm the findings in the pregnant women. That is, those monkeys which were injected with pregnancy urine extract seemed to show some degree of epithelial hyperplasia both with and without inflammatory changes. The finding of this hyperplasia in monkey No. 123 without any accompanying inflammatory reaction seemed very significant. In this monkey we had for comparison another papilla removed before injection. This showed an inflammatory reaction in the posterior or dental mucosa but without epithelial hyperplasia either anteriorly or posteriorly. If this finding can be confirmed by other similar experiments I believe that we can regard the question as settled.

EVALUATION AND CONCLUSION

1. While irritants are usually found associated with gingivitis in pregnant women this affection may develop in the absence of such irritants. Hence it would seem that irritation is a complicating factor rather than a causative one.

2. Since traumatic hemorrhage from the gums begins so often after the onset of gestation it is probably a complication of pregnancy.

3. Because hyperplasia is the most notable change in the epithelium because it increases

with advance in pregnancy, and because it is also commonly present in certain organs of reproduction during this state, it seems probable that pregnancy plays an etiological rôle in the production of epithelial hyperplasia.

4. The inflammatory changes in the submucosa cannot be linked with the month of pregnancy. Consequently they are probably secondary in character.

5. Gross changes, resembling pregnancy gingivitis, produced in the monkey by injection of pregnancy urine extract were found microscopically to be hyperplasia of the epithelium pointing to the probability that the hormones were the causative agents.

6. One monkey No. 123 showed hyperplasia of the epithelium, without inflammatory changes in the submucosa. This leads us to believe that epithelial hyperplasia is the primary change.

7. The significant change in the gums in pregnancy gingivitis is hyperplasia of the epithelium.

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THE EFFECT ON THE INFANT OF MORPHINE ADMINISTERED IN LABOR

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THE relief of pain during childbirth has interested scientific workers for generations. The search for new and more effective sedative agents has been carried on for a century. Scarcely a month passes without the introduction of some new drug guaranteed to banish its age old pains without doing harm to the mother and her newborn baby. The fact that the obstetrical attendant has so many new and old drugs at his disposal—all exploited to do the impossible—speaks for their relative ineffectiveness. Likewise, such drugs are not as innocuous for both mother and child as their manufacturers would have us believe. The ideal analgesic in labor has not yet been discovered. The majority of us still find that morphine or its derivatives, alone or combined with some other agent is the most useful and the least dangerous. At the Chicago Lying in Hospital we have tried many of the various new agents introduced but we have invariably returned to morphine. Many other institutions and practitioners have had the same experience. What is there in morphine narcosis during labor that prevents it from being the ideal analgesic? Undoubtedly it is the effect that the drug has occasionally on the newborn baby. This so called "narcotization" of the newly born has given obstetricians many anxious moments. Difficulty with the baby after a normal pregnancy and successful labor is not a welcome experience. It has occurred to us that a careful study of the effect of narcosis on the newly born, including the evaluation of all the factors that enter into the picture would be a timely contribution. We have always had the opinion that the frequency of occurrence of asphyxia due to morphine was overemphasized, and its prognosis made unduly grave. Moreover no detailed observations on this subject have appeared in the literature since the early days of twilight sleep—25 years ago.

CLINICAL OBSERVATIONS

Our study consists of observations on 320 infants, including three sets of twins, born at the Chicago Lying in Hospital during the year 1932. The mothers of these infants received varying doses of morphine sulphate alone or in combination with other drugs for the relief of pain during labor. In some instances the large dosages used and the time intervals at which they were administered were designed primarily for this study. The cases for the most part, were unselected but the series includes a disproportionately large number of cesarean sections because they were better suited for this problem. In them we could control more accurately the time interval between the administration of the drug and the birth of the baby, as well as rule out many complicating traumatic factors involved in delivery *via* the natural passages. Throughout this paper "morphine" refers to morphine sulphate unless otherwise noted, and all figures which are mentioned are in terms of morphine sulphate.

Early in this study it became apparent that the picture which we know as 'narcosis of the newly born' may be influenced by a variety of factors. There is likewise an extraordinary variability in the manner in which different babies will react to identical conditions. The most important of these factors are the size of the dose, the interval between its exhibition and the time of delivery, the extent of the trauma of delivery, the condition of the child *in utero*, maternal toxemia, anaesthesia, and adjuvant sedatives used. All of these factors were studied separately wherever possible and also collectively in order to evaluate the true pharmacological action of morphine on the baby when administered to the mother in labor. It is interesting to note that a large number of infants born under optimum conditions for the production of narcosis showed no trace of the effects of the drug.

The size of the dose of morphine seems to have relatively little influence on the production of narcosis in the newborn. Its incidence was as great when dosages of 0.0003 and 0.0005 grams were used, as when 0.03 gram was used. In some instances, however, the larger dosages caused marked narcosis in the child.

The time interval between the administration of the drug and the birth of the baby is the most important factor in the occurrence of neonatal narcosis. During the first hour following the exhibition of the drug, few babies show any signs of narcosis, and after 6 hours the same is true. In Figure 1 this is well demonstrated. The incidence of narcosis becomes progressively greater in the second and third hours after its administration, reaching a peak at about 3½ hours. Seventy-seven per cent of the babies narcotized from the use of 0.010 gram of morphine and 72 per cent after the use of 0.015 gram fall within this 5 hour period. It is even more noteworthy that 25 of our 26 cases of really deep narcosis fall within this time interval. As the curves demonstrate, from 10 to 15 per cent of all babies showed symptoms of narcosis without regard to the time elapsing after such use. The rôle played by the drug in the production of such asphyxia is impossible to evaluate. If the child is pallid rather than livid with large pupils which remain large, when it reacts poorly to external physical stimuli and to gas resuscitation, one may be sure that other factors play the major part. The trauma of labor especially is a significant and confusing factor here. A good example is a case in which we gave pituitrin following the birth of the first baby of a pair of undiagnosed twins. The mother had had morphia during labor. The first child was normal in every way. The second and better developed baby came with a rush following a single hard pain and was deeply narcotized.

When other drugs are used with morphine to increase or prolong its sedative action their combined effects are variable, depending on the adjuvant drug. Scopolamine, when combined with morphine tends toward a cumulative effect thereby increasing the incidence of narcosis in the newly born. This was denied

vigorously by Gauss, who thought that scopolamine was harmless to the newly born. He thought that morphine was the offender in the combination which he used first, and by reducing its amount he decreased the incidence of narcosis. Hochstein cited one instance of infant "oligopnea," due, however to scopolamine alone. Van Hoesen claimed that morphine was responsible for the entire narcotic effect on the infant produced by morphine and scopolamine combinations. In our experience the complementing of morphia with sodium luminal or magnesium sulphate did not increase the incidence of neonatal narcosis.

The gestational age of the baby and its weight do not appear to be important factors in the occurrence of narcosis in the newly born. In Table I there are a number of cases cited in which very small previable babies began spontaneous respirations immediately after birth without any evidence of narcosis although their mothers had received large doses of morphine in labor. As a large majority of our babies were at term and of normal weight it is difficult to decide conclusively as to the influence of the weight of the child on the incidence of narcosis. However of the 320 babies in our series, 28 weighed 2000 grams or less. In this small group 15 babies were delivered without complicating factors, such as trauma, maternal toxemia, or intrauterine asphyxia. It is most interesting to note that none of the 15 showed any symptoms of morphia narcosis at birth. The average dose of morphine used in this group was as large or larger than that used in the entire group of cases. Indeed, in some of these patients unusually large and frequent doses of morphine had been used in an attempt to postpone a threatening premature labor. The mortality figures are also very suggestive. There were 40 babies weighing 2500 grams or less at birth and of these, 12 or 30 per cent, died. The mortality of the 17 babies weighing from 1500 to 2500 grams was 6 or 32 per cent. These figures compare favorably with the corresponding figure for the period from October 1, 1932 to April 1, 1933 at the Chicago Lying in Hospital. We had 1618 infants, of whom 127 weighed 2500 grams or

TABLE I
Pathological Findings in all Babies Who Died in the Entire Series of Cases

| Number | Child | Weight | Lived | Previa | Premature | Intra-cranial hæmorrhage | Dural lacerations | Atelectasis | Miscellaneous |
|--------|-------|-------------|---------------|--------|-----------|--------------------------|-------------------|-------------|--|
| 66000 | O | 440 | 2 min. | + | + | | | + | |
| 66009 | O | 478 | 2 min. | + | + | | | + | |
| 66095 | B | 2,030 | 30 min. | + | + | + | | + | |
| 66184 | H | 2,373 | 8 hours | | + | + | | + | Early bronchopneumonia |
| 55700 | Y | 4,159 | 57 min. | | | | | + | Marked secondary anemia of mother |
| 54759 | S | 2,670 | 4 hours | | + | | | + | Large thymic petechiæ of lungs and heart |
| 66381 | S | 705 | 2½ hours | + | + | | + | + | |
| 37374 | T | 1,665 | 1 hr. 40 min. | | + | | | + | Petechiæ of lungs |
| 4025 | G | 2,350 | 20 min. (?) | | + | | | + | |
| 55324 | W | 2,450 | 7 hours | + | + | | | + | |
| 59180 | B | 2,000 | 4 days | | | + | | + | Abruptio placentæ. Child had 75 per cent hæmoglobin |
| 55403 | S | 2,450 | 4 days | | | No autopsy | | | Hæmorrhagic purpura |
| 66403 | A | 2,705 | | | + | No autopsy | | | |
| 67859 | G | 2,720 | | | + | No autopsy | | | |
| 66578 | R | 2,040 | Several hours | | + | | | + | |
| 60105 | E | 760 | | + | + | | | | Incomplete rotation of gut and descent of testis |
| 7176 | K | 450 | 0 min. | + | + | | | + | |
| 55501 | B | 7 (4½ mos.) | 30 min. | + | + | | | + | |
| 55556 | C | 705 | 75 min. | | + | No autopsy | | | |
| 71887 | C | 1,000 | 3 hours | | + | No autopsy | | | Placenta prævia |
| 51350 | Mic | 4,405 | 0 days | | | | | | Meningitis from laceration of scalp produced in delivery |

less. Thirty-eight of the 127 died making a mortality of 30 per cent—exactly the same as the above.

Maternal toxæmia always has been regarded as a contributory factor in the causation of asphyxia neonatorum. Many babies born of toxæmic mothers show definite signs of intoxication. A considerably higher proportion of these babies are lost during and immediately after delivery as a result of the usual trauma of labor. In a recent unpublished paper Adair cites significant statistics from the Chicago Lying in Hospital covering approximately the last 13½ years. In that time there were 262 cases of non-convulsive toxæmia with 264 babies, and 17 convulsive cases

with 17 babies. In the 264 babies delivered of the non convulsive patients there were 10 previable, 23 premature and 11 deaths at term. This represents a fetal mortality of 16.7 per cent. Of the 44 who died, autopsy examinations were made in 15 and 6, or 40 per cent, showed intracranial hæmorrhages or gross dural lacerations. The fetal mortality of the hospital from July 1, 1931 to April 1, 1933 was 4.4 per cent for 4,730 births. In the same period of time postmortem examinations were made in 218 of our babies, and of these 34 per cent showed such intracranial hæmorrhage or laceration.

One might suspect that babies born of toxæmic mothers would be more susceptible

TABLE II.

Pathological Findings in the Dead Babies Born of Mothers with Toxemia.

| Number | Child | Weight | Previa | Promoteur | Intra-uterine hemorrhage | Dural lacera-tion | Abdominal | Remarks |
|--------|-------|--------|--------|-----------|--------------------------|-------------------|-----------|---|
| 60376 | R | 3,840 | | + | | | + | |
| 44893 | B | 1,840 | + | + | + | | + | |
| 60531 | S | 793 | + | | | + | + | |
| 55709 | Y | 4,150 | | | | | + | Mother had marked secondary anemia. Lived 17 months |
| 30740 | B | 3,090 | | | + | | + | Abnormal placenta. Lived 4 days. Child had 71 per cent hemophilia |

to morphine. In our group of mothers exhibiting the usual symptoms and signs of toxemia 36 per cent of the babies were born with evidence of narcosis, and 12 per cent had very deep narcosis. On the other hand, the incidence of narcosis in our entire group of babies was only 26 per cent, and only 8.4 per cent showed deep narcosis. Fully 5 of the 21 dead babies in our series had a history of maternal toxemia. The autopsy findings in these babies are summarized in Table II.

Asphyxia *in utero* as is indicated by a change in the rate or rhythm of the fetal heart, apparently leads to an increased susceptibility of the infant to morphine. In our series 22 babies showed signs of asphyxia *in utero*. Of this group 69 per cent showed symptoms of 'narcosis' at birth while 30 per cent were in deep narcosis. One must bear in mind the fact that it is often difficult to determine the true cause of asphyxia. However it is certain that morphine played an important rôle in its causation. In none of our cases did a baby die *in utero*. Veit remarked that he had never seen morphine affect a baby *in utero*. Gauss reported 4 stillbirths in his first 500 cases of twilight sleep. Siegel reported 2.5 per cent in 200 cases while Preller reported one intra uterine death in 200 cases of this sort. Statistics from our own clinic over a period of 12 years and 11 months, show an average of 2.7 per cent stillbirths in 35,179 deliveries.

That the infant *in utero* can tolerate large doses of morphine over a period of days or even months without showing any unusual effects is a most interesting observation. We have given morphine for days to mothers

threatening to go into premature labor only to have a previable or premature baby born without any signs of narcosis. Mueller Reiche, and Langstein have reported on the deliveries of addicts. Reiche cites a case in which a pregnant woman took from 0.1 to 0.2 gram of morphine daily. In the last month of pregnancy she had as much as 0.25 gram per day and delivered a normal healthy child. Langstein had 4 addict cases and in only 1 instance was the baby even blue at birth. From these observations one can conclude that morphine does not affect the child *in utero* unless it is born within approximately 6 hours of the last dose. Its effects on the respiratory center which probably remains entirely quiescent during the intra-uterine existence of the child, is first demonstrable at birth. The effect is definitely not cumulative. This correlates well with our observations on the effect of repeated doses in labor.

Traumatized babies and those who have been subjected to long or difficult labors or operative procedures are more susceptible to morphine narcosis. This is well illustrated in our unusually large group of 64 cesarean sections. Here nearly all of the babies were delivered ideally as far as the element of trauma is concerned. Six of these patients received 0.3 gram of morphine at varying time intervals before operation and the majority of the others had at least one dose of 0.15 gram. These babies had the minimal incidence of narcosis—11 per cent. All but one of the babies with symptoms of narcosis were extracted from the uterus with difficulty.

Of our series 39 cases had difficult operative deliveries *per vaginam*. Moreover in the ma-

jointy of instances a long labor preceded the delivery. In 23 of the 39 cases there were no other complicating factors, yet in this small group 52 per cent showed "narcosis." The importance of trauma as a predisposing cause is further evidenced by the greater incidence of narcosis in primiparae, namely, 30 per cent, as compared with 21 per cent in multiparae.

The effect of the drug on the mother is some indication of its probable effect on her child. Eight of our mothers showed an unusual response to the morphine. Seventy five per cent of these deeply narcotized mothers had deeply narcotized infants. The size of the mother's pupils is not as useful a guide as the respiratory rate in estimating the depth of maternal narcosis. One of the mothers subjected to caesarean section had two doses of morphine, 0.15 gram each, which slowed the respirations to 12 per minute during the operation. Her pupils were of pin point size. The baby was delivered easily but was born deeply narcotized. It did not breathe normally for 18 minutes and its pupils were contracted for hours. It had spells of cyanosis with apnoea for a period of 9 hours and its tongue was almost black for 20 hours. It made an uneventful recovery.

Inhalation anaesthesia during labor, like wise predisposes to narcosis in the newly born. We used ether in only 7 cases and can draw no conclusions as to its effect. However, we used ethylene-oxygen in 199 cases. The length of time during which the anaesthetic was administered seemed to be of no significance, but narcosis was about twice as frequent as when local anaesthesia was used. The latter was used in 113 cases (Fig. 2).

Referring to Figure 1, which shows graphically the incidence of narcosis at varying intervals following the administration of morphine one notes that the most marked correction for the complicating factors discussed above is necessary during the time interval that the morphine has its maximum effect on the child—1 to 6 hours after the exhibition of the drug. This leads to the conclusion that the child is most susceptible to trauma, toxemia, intra uterine asphyxia, anaesthesia etc. during the time that it is under the influence of the drug. This susceptibility increases as the maximum

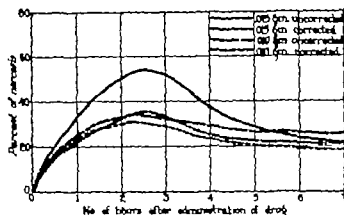


Fig. 1. Incidence of narcosis.

influence of the drug on the child is reached. Clinically, then, morphine should be used most cautiously toward the end of prolonged complicated labors where the child may be subjected to considerable trauma at delivery. Here the time interval between the use of the drug and the delivery of the child is of utmost importance.

EXPERIMENTAL DATA

As controls for our clinical observations on the effects of morphine we chose 12 newborn infants. These babies had been born by easy, spontaneous deliveries and in all but one case of multiparae. They varied in age from 3 hours to 4 days. They were entirely normal and none of their mothers had had any sedative during labor. These infants were given varying dosages of morphine intramuscularly. Three received 0.0004, two 0.0007, three 0.0009, one 0.001 and two 0.004 gram. They were then observed very carefully over a period of 48 hours. The dose of 0.0004 gram produced little effect. All of the larger doses produced a characteristic picture, which began to develop in 20 minutes and was complete in about 1 hour. Such a baby first became drowsy and increasingly more difficult to awaken. On stimulation it cried briefly and then returned to sleep, often its mouth remained open for some time as if it halted in the midst of its cry. This we soon came to regard as the characteristic "morphine cry." Continued stimulation of such babies often made them apnoeic. They became deeply cyanosed and held their breath for as long as 2 minutes at a time. Such apnoea ended with a sudden gasp or two, with the return of bet

ter respirations and a more normal color. When such babies were put to the breast they were too drowsy to nurse. When the attendants or mothers urged them to nurse they were very much frightened by the appearance of the apnoea and cyanosis described above. On being left alone without handling the babies soon appeared normal although the respirations might be slowed to as few as 20 per minute, and the heart rate was correspondingly decreased. Their color remained normal and their pupils were of pin-point size. This morphine picture averaged 8 hours in length although in some instances it lasted as long as 15 hours.

Contrast the above picture with narcosis of the child at birth. It may take one or more spontaneous breaths immediately at delivery only to lapse into apnoea or apnoea may be present without the preliminary respirations. Cyanosis develops coincident with the apnoea and becomes progressively more marked with the continuation of the latter. The child moves its extremities and wrinkles its face spontaneously or on stimulation. It may grimace or attempt to cry without the utterance of a sound. The reflexes are present and its muscles are quite tonic. The heart beat slows but remains strong and the circulation active. Its pupils are normal in size or dilated and on resuscitation promptly contract to pin point size. With suitable carbon-dioxide oxygen mixtures these babies are resuscitated promptly and once normal respiration begins it persists. There is no tendency to relapse into apnoea.

Although the reaction of this experimental group of babies to external stimulation was the same as in the newly-born group their response to carbon dioxide and oxygen mixtures was much different. As soon as the gas mask was applied the respirations became deeper their eyes opened their color improved, and they responded to stimulation with a fairly good cry. As soon as the mask was removed the child at once relapsed into its former sleep. The response to the more concentrated mixtures of carbon dioxide is definitely better than to the less concentrated. The 30 per cent carbon dioxide and 70 per cent oxygen mixture was the most effective.

The literature contains numerous references on the tolerance of very young infants for opiates. Fleischer's case, an infant 7 weeks old weighing 5 kilograms, tolerated 0.04 gram of morphine. Ravenna mentioned a 17 month old baby who tolerated 0.010 gram. Wichura reported a 3 month old child weighing 4,600 grams, who tolerated 0.02 gram. Mason had a 56 hour old baby who tolerated 0.008 gram. Porzelt had an 8 month old child who tolerated 0.02 gram and Sirwinaki had a similar experience with a child 1 year old. Kaljser reported a 10 day old child who tolerated 0.01 gram. However, Webster cites the case of a 3 year old child who reacted badly to 2 drops of paregoric and Kaljser reviewed the literature, emphasizing the danger of opiates for children. Klemm, Lehnendorff, Knoepfelmaier, Riether and Erlendsson have also made interesting contributions on this subject.

The speed with which morphine is transmitted from the mother to the child was studied. Morphine 0.015 gram was administered to different mothers 2, 3, 4, 5 and 6 minutes, respectively, before the child was delivered and the cord was cut. The stools of the infants were examined daily during their stay in the hospital for the presence of morphine. The qualitative tests used were the Marquis which readily detects 0.0002 gram of pure morphine and the Wasicky which detects less than 0.0005 gram. All of these babies first showed positive tests for morphine when bile appeared in the stools on the third or fourth day of life. Some of these infants who died shortly after birth gave strongly positive tests in the tissues of the brain and the liver. The stomach or bowel contents gave negative tests, as Brock had reported previously. These observations support the idea that morphine is eliminated by the liver. Many workers have found that its maximum concentration in the body is in the liver and the brain.

All of the babies whose mothers had received morphine gave positive tests for morphine in their stools the detection being easiest from the fourth to the seventh day. In our work we attempted to determine the sensitivity of the tests used. We administered smaller and smaller doses of morphine

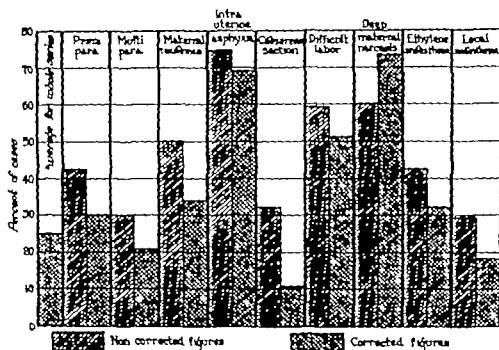


Fig. 3

intramuscularly to newly born babies and obtained definitely positive reactions in such stools when the baby received as little as 0.00002 gram. This indicates that these tests are much more sensitive than is the opinion because only a very small fraction of the minute dose given to the baby could appear in the tiny portion of the stool examined.

Reiche, in working on dogs, demonstrated that morphine given to the mother does not appear in her milk, and cites Walter's corroborative work. Our work shows that morphine appears in the stools of both breast fed and wholly bottle-fed infants in an identical way, thus substantiating Reiche's experiments. The Wasicky test is differential for morphine and its first oxidation product—pseudomorphine. We have never been able to detect pseudomorphine in the tissues or stools of our babies.

In our work we developed a slight modification of the Wasicky test. In the original test a drop of the specially prepared Wasicky reagent is added to the substance to be tested and the mixture is then heated, whereupon an intense red color appears. In place of heating the mixture, a small drop of water may be added and this will produce promptly a definite violet or purple color if the substance tested contains morphine. This simplifies the test considerably. However, atropine gives a

similar violet reaction so of course this modification can be used only where no atropine has been given.

The fact that morphia passed over from mother to fetus so rapidly suggested that the placenta was a very ineffective barrier. Dr. Adair advised us to analyze some of the placentas quantitatively to determine if morphia given to the mother a few hours before delivery accumulated in the placenta. We added together two placentas, their total weight being 900 grams. The mothers had received a total of 0.061 gram of morphine. The qualitative tests on the pulp were positive of course. However, quantitative estimations by the Gauss method, which detects 0.000003 gram of pure morphine colorimetrically and from 0.0001 to 0.0005 gram quantitatively, were negative. This experiment would indicate that the placenta does not retain morphine and is not an important barrier to the passage of morphine to the fetus.

Cloetta, in experiments on animals, found that morphia disappeared from the circulation in 20 minutes. He gave 0.3 gram subcutaneously to a dog and 1 hour later he could find none in the brain. To a second dog he gave 0.4 gram intravenously and the brain revealed no evidence of morphine in 15 minutes, but the liver showed a considerable quantity of it.

Another animal given 0.5 gram showed similar findings. Wachtel gave from 0.4 to 0.8 gram of morphia to dogs and recovered some in the brain but none in the liver. He noticed that it disappeared almost at once from the blood stream. Lautenschlager gave 0.2 gram intravenously to rabbits. When the animals were killed 3 hours later the brain and stomach contents gave negative reactions for morphine but the liver blood and urine were weakly positive.

We were interested in studying the quantitative amount of morphine actually transmitted to the child by the maternal circulation. We analyzed the brains and medullas of 6 infants who died very soon after delivery. The mothers of these infants all received the accepted sedative dosages of morphine during labor. The medulla and brain were taken together because Lumsden has discovered the presence of several respiratory centers in the medulla and brain. The tissues were removed as soon as possible after death and analyzed by the same quantitative method of Gauss mentioned. We did not recover morphine in a quantitatively measurable amount in any of the 6 babies, although in 1 case a baby weighing 450 grams whose mother had been given seven doses of 0.15 gram and one dose of 0.10 gram in the 30 hours preceding delivery we obtained a definite qualitative reaction. In 2 of these 6 cases an analysis of the liver also proved to be negative for morphine. An interesting observation is that qualitatively the brains and livers of all of these babies gave positive reactions with the Wasicky or Marquis tests. This would indicate the presence of morphia in the tissues in amounts too minute to measure quantitatively.

Two moribund babies whose mothers had not received morphine were injected with the drug after delivery. The first a previsible baby of 1520 grams, with a large meningocele and a hydrocephalus, received 0.0014 gram intramuscularly 45 minutes before its heart stopped. The second baby moribund and weighing 1975 grams received the same dose 18 minutes before its heart stopped. The brains and livers were analyzed qualitatively and quantitatively immediately after death. The tissues in the first case gave a

positive qualitative reaction with the Gauss technique, although the amount of morphia was too small to measure quantitatively. In the second case a negative qualitative and quantitative reaction was obtained with the Gauss technique. We can therefore conclude that babies receive less than 0.0014 gram of morphine through the maternal circulation in the usual case of morphine analgesia. Only where huge doses are given does a comparable amount pass over to the fetus. As mentioned before, such a dose does not produce the signs of 'narcosis of the newborn' when administered after birth.

DISCUSSION OF LITERATURE

The literature contains some interesting reports on the effects of morphine on animals. It is well known that the usual experimental animals have various reactions to morphine. In our earlier work we gave huge doses of morphine to pregnant rabbits, totaling as much as 0.23 gram per rabbit, over a period of 2 days. Except for a transient drowsiness and a sluggish reaction to the usual stimuli they showed no other demonstrable effects. Such animals had litters which were delivered uneventfully and the young appeared entirely normal. There is, likewise a distinct variation in the reaction of individual animals of the same species. These interesting facts rule out much of the usefulness of the experimental animal in our problem.

Schoen removed various parts of the brains of animals and found that the same dose of morphine could produce opposite effects, depending on the parts removed. Hegar found that a morphinized mouse survived asphyxia twice as long as a normal mouse and concluded that morphia decreased the organic need for ventilation. Meltzer and Steuber found that cutting the vagi did not modify the effect of morphine on respirations. However Maloney and Tatum disagree with this finding. Pierce and Plant found that the recovery of morphine from the urine and feces combined did not exceed 30 per cent of the intake. Light, Torrance, Karr Fry and Wolff cite investigations of other workers, showing that the muscles take up rapidly large doses of morphia and leave only small

amounts free to reach the central nervous system. The excretion or destruction of morphine must be rapid, for in 8 to 10 days a cured addict may die from the effects of the dose he had usually taken before. They also point out how little of the total intake is recoverable from the urine and feces.

There is an extensive literature giving the clinical observations on the use of morphine. Much of this dates back to the era of "twilight sleep," when many clinicians first became interested in the technique. No extensive studies have appeared recently, so facts and fallacies together remain in the literature to confuse the student. DeLee states that morphine is relatively safe when given more than 4 hours and less than a half hour before delivery. Aufermann gave morphine intravenously and found that its action was felt at most for $2\frac{1}{4}$ to 3 hours. McIlroy, in a recent paper, revised her earlier opinion on the subject and states that morphine should not be used in primigravida within 3 hours of delivery. There are other interesting discussions on the subject by Brock, Williamson, Spencer, and Thaler. The articles on "twilight sleep" by Suzs, Smith, Hochlesen, and von Bardeleben are also very instructive.

SUMMARY AND CONCLUSIONS

In our study on morphine narcosis in the newborn, methods of resuscitation necessarily must be considered. (The old and standard methods are useful in these cases, as in the treatment of "asphyxia" due to other causes.) The air passages should be cleared by means of a tracheal catheter if necessary and external warmth should be applied. However external stimulation of any kind is not only of very doubtful value here but it often serves only to deepen the narcosis. Such stimuli may cause the baby to inspire once or twice and then to lapse into apnea, from which it is difficult to arouse. Thus morphinized babies should be handled gently. A mixture of carbon dioxide and oxygen gases proved to be the most useful stimulus to respiration. Indeed, after our work proceeded for some time we began to regard the reaction of morphinized babies to these gases as a criterion of

true narcosis. We finally concluded that a brief administration of 30 per cent carbon dioxide with 70 per cent oxygen was the ideal mixture especially effective when followed by pure oxygen. A complete report on this method of resuscitation has been published recently by us.

In Table I there is summarized an account of all of the fetal deaths in our series together with the pathological findings where autopsies were done. We felt that no baby in this group was lost as a result of morphine narcosis. Indeed it has been our experience that morphine is a safe drug to use in labor, especially when adequate means of resuscitation are at hand. Many clinicians have relegated this drug to the background because of the possible development of the unpleasant complications of narcosis only to make use of far more dangerous drugs of doubtful analgesic value.

A few reports on morphia derivatives have appeared recently in the literature. Very slight changes in the structure of the morphine radicle seem to modify markedly the essential pharmacological effects. Alvarez and Leulier and Pomme have written on dilaudid and oxydimorphine sulphonate respectively. Can some slight change in the constitution of morphine occur in the body from 1 to 6 hours after its administration sufficient to explain the peculiarities of its effect on the fetus? The effect seen in the newly born cannot be reproduced when various dosages of morphine are injected into infants a few hours old. Yet we have observed that morphine or a form of morphia so much similar that it answered to the test reactions for morphia hitherto devised passed over into the fetus within 2 or 3 minutes after it was given to the mother. Infants born before an hour had elapsed or after 6 hours showed little if any narcotic effect from the same. During the time when the drug tends to act most strongly on the child only 50 per cent are affected by it to any noticeable degree. This effect disappears almost immediately with proper methods of resuscitation and for some strange reason does not recur. One cannot reproduce this particular phenomenon with any drug that we know of in any dose—certainly not with doses of morphine given after birth. Such a

change in the drug cannot be due to its oxidation to pseudomorphine as the differential Wasicky test did not reveal the presence of pseudomorphine in any of our studies. Balls has shown how difficult it is to detect the brief pseudomorphine stage, and its properties, as he recounts them are very different from the effects produced on our newly borns. It is of interest to observe that the maternal response to morphia is maximal at about the same time as the newly borns show that the drug is most effective on their respiratory mechanism. Further research may produce a derivative of morphine just as effective for the relief of maternal pain and less toxic to infants *in utero* as demonstrated immediately at birth.

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EFFECT OF SYMPATHETIC NEURECTOMY ON THE COLLATERAL ARTERIOLE CIRCULATION OF THE EXTREMITIES

EXPERIMENTAL STUDY

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SYMPATHETIC neurectomy of the vasoconstrictor control of an extremity has given encouraging results in selected clinical cases of obstructive arterial disease (1, 19, 30, 34). The increased peripheral circulation following denervation is manifested by a permanent rise in temperature of the limb (7, 12, 20, 33), improved calorimetric (9, 13) and oscillometric (38, 42) findings as well as relief from distressing subjective symptoms due to circulatory deficiency. In the presence of mechanical obstruction in the main artery this improvement must occur through functionally active collateral vessels. When the collateral channels are involved in the organic obstructive arterial disease there is little possibility of improving the circulation. Pre-operative clinical tests (10, 16, 18, 29, 35, 40, 44) for the functional activity of the collaterals are the basis for selecting cases of peripheral circulatory deficiency suitable for operation. The collateral vessels in these cases are functionally comparable to the normal circulatory channels of experimental animals.

The present investigation is to determine the influence of sympathetic denervation in hastening and augmenting vasodilatation of the collateral arterioles in experimental animals. Actual blood volume flow, direct blood pressure and superficial and deep temperatures are used to study the peripheral circulatory changes. This report is based upon the results obtained from 260 experiments upon 110 dogs.

PRINCIPLES OF EXPERIMENTS

Ligation of the femoral artery just below Poupart's ligament confined the main peripheral arterial circulation to the collateral channels (Fig. 1). Vasodilatation of the existing collateral arterioles or formation of new anastomoses was determined by changes in the arteriole circulation with and without

sympathetic denervation. Distal cannulization of the ligated artery permitted actual blood flow and direct blood pressure observations. The use of the same cannula in the elastic femoral arteries assures the constancy in the size of the outlet in all the experiments. Therefore dilatation of the existing collateral arterioles would result in an increased blood flow through the cannula accompanied by a corresponding change in blood pressure. On the other hand the opening of the new collateral arteriole channels may provide an increased circulation with little variation in peripheral blood pressure. Consequently the results of blood volume flow and direct blood pressure determinations in the following experiments give direct information as to the changes in the collateral arteriole channels. It is possible therefore to compare the results with and without sympathetic denervation at corresponding periods after main artery ligation.

TECHNIQUE OF EXPERIMENTS

A large female dog was anesthetized with morphine sulphate 1 grain supplemented with the inhalation of a minimum amount of ether. Transperitoneal lumbar sympathetic neurectomy was performed from the first lumbar vertebra to the first sacral. Immediately following left lumbar denervation the left and then the right femoral arteries were isolated through small incisions just below Poupart's ligament. The superficial temperature was obtained by inserting a mercury thermometer subcutaneously between the skin and the internal condyle of the femur. A 2 minute reading was obtained. The thermometer was then placed deeply in the thigh muscles for 2 minutes to obtain the deep temperature. A No. 18 gauge transfusion cannula was introduced into the superficial femoral artery distal to the ligation (Fig. 1). For blood to flow through the cannula necessitated circulation

¹From the Department of Surgery, Rush Medical College of the University of Chicago.

through the collateral channels around the ligated main artery. Minute flow calculations were obtained from the amount collected in 15, 20, or 30 seconds to avoid exsanguinating the animal. Direct blood pressures were obtained by means of a mercury manometer. The determinations were made on the left sympathetomized and right unsympathetomized limb for comparison.

The following results were obtained:

Dog 91, operated upon April 8, 1932

| Immediately after operation | | Left Sympathetomized | Right Unsympathetomized |
|---|--|-------------------------|----------------------------|
| Temperature—superficial | | 97° | 97° |
| deep | | 96° | 96° |
| Blood pressure | | 70 mm. | 66 mm. |
| Blood volume flow—1 minute | | 4.8 cm. | 37 cm. |
| Blood volume flow—4 minutes | | 14.3 cm. | 33 cm. |
| Seven months later— November 4, 1932 | | | |
| Temperature—superficial | | 97° | 97° |
| deep | | 96° | 96° |
| Blood pressure | | 100 mm. | 96 mm. |
| Blood volume flow—1 minute | | 1 cm. | 76 cm. |
| Blood volume flow—4 minutes | | 38 cm. | 96 cm. |
| Blood volume flow—1 minute | | 16 cm. | 96 cm. |

It will be noticed that the blood flow, blood pressure, and deep temperature readings are constantly higher on the left sympathetomized limb. However 7 months following sympathectomy the superficial cutaneous temperature is 4 degrees lower (93 degrees) than the temperature on the unsympathetomized right side (97 degrees).

To eliminate the effects of prolonged anesthesia and operative manipulations and to evaluate the permanency of the circulatory changes the experiments were grouped in the following series:

1. *Normal findings.* Normal collateral arteriole circulation was studied on the right and left hind limb without sympathetic denervation. Blood volume flow and direct blood pressure determinations were repeated at intervals of weeks and months to obtain the normal physiological improvement in the arterioles following occlusion of the main artery.

2. *Immediate effect of sympathectomy.* Immediate effect of lumbar sympathetic neurectomy was determined from the findings obtained on the two legs before and after unilateral denervation.

3. *Late effects.* Rapidity and permanency of arteriole circulatory improvement was determined at intervals of weeks and months following sympathectomy. These results can then be compared with those obtained at the same time on the opposite unsympathetomized limb as well as the normal obtained in (1).

4. *Cutaneous and deep circulatory changes.* Correlation of the constancy of arteriole circulatory changes following sympathectomy with the capillary skin temperature findings.

Normal collateral arteriole circulation with out denervation was determined by distal cannulization of the ligated femoral artery. The constancy of blood flow and blood pressure of the right and left hind legs was verified. The results were almost uniform on the two sides and demonstrated that the effect of sympathectomy may be studied on the one side with the other as control. The following results are representative of those observed in this series:

Dog 68, operated upon February 21, 1932. Femoral artery ligation without sympathectomy

| Immediate unsympathetomized determinations | | Left | Right |
|---|--|------------|---------|
| Blood pressure | | 38 mm. | 38 mm. |
| Blood volume flow—1 minute | | 35.1 c.cm. | 33 cm. |
| Blood volume flow—4 minutes | | 37 cm. | 36 cm. |
| Temperature—superficial | | 97° | 97° |
| deep | | 91.4° | 101.5° |
| Nine months unsympathetomized determinations (November 1, 1932) | | Left | Right |
| Blood pressure | | 36 mm. | 36 mm. |
| Blood volume flow—1 minute | | 35 cm. | 133 cm. |
| Blood volume flow—4 minutes | | 38 cm. | 96 cm. |
| Temperature—superficial | | 94.2° | 96° |
| deep | | 96.2° | 96.2° |

The immediate effect of sympathectomy was obtained by blood flow and blood pressure findings on the two legs before and after left lumbar sympathectomy. The left sympathectomized limb in some instances had as much as a 100 per cent increase in collateral blood flow while the findings on the right unsympathetomized limb remained unchanged. The fact that the findings on the control limb remained unchanged after opposite side denervation emphasizes unilateral sympathetic vasomotor control. Kuntz (25) believes that a crossed sympathetic control may also exist. The direct blood pressure readings were constantly higher on the sympathetomized side, although to a much less degree than would be expected by the markedly increased blood flow. A 60 per cent average increase in blood volume flow following sympathectomy is associated with a 15 per cent average rise in blood pressure (Fig. 2).

Representative findings of this group are

Dog 46, operated upon November 20, 1930.

| Control determinations before sympathectomy | | Left | Right |
|---|--|--------|----------|
| Blood volume flow—1 minute | | 34 cm. | 30 c.cm. |
| Blood volume flow—4 minutes | | 33 cm. | 33 cm. |
| Blood volume flow—1 minute | | 31 cm. | 36 cm. |
| Temperature—superficial | | 94° | 97° |
| deep | | 92° | 94° |

| Immediately following left lumbar sympathectomy | Sympathetic tonized | Unsympathetic tonized |
|---|---------------------|-----------------------|
| Blood volume flow—1 minute | 48 c.cm. | 24 c.cm. |
| Blood volume flow—1 minute | 48 c.cm. | 31 c.cm. |
| Blood volume flow—1 minute | | 29 c.cm. |
| Temperature—superficial | 94.4° | 93.0° |
| deep | 90.4 | 90.8° |
| Blood pressure | 60 mm. | 50 mm. |

Late effects The rapidity and permanency of arteriole circulatory improvement was ascertained by repeating the determinations at intervals of 2 weeks to 10 months after sympathetic denervation. Gradually increasing arteriole circulation on the right unsympathetomized limb demonstrated the physiological response to main artery occlusion. A definitely greater increase was constantly found on the left sympathectomized limb (Fig. 3). Ten months was considered sufficient time for permanency of the changes to take place. At this time the blood pressure distal to the ligature (arteriole pressure) on the left sympathectomized limb equals the normal systemic arterial pressure of 120 to 140 millimeters of mercury. On the unsympathetomized right side the blood pressure constantly remained from 10 to 30 millimeters lower and did not return to the normal systemic level at any time (Fig. 4).

Dog 71 left lumbar sympathectomy performed March 18 1932

| Immediately after left sympathectomy | Left Sympathetic tonized | Right Unsympathetic tonized |
|--------------------------------------|--------------------------|-----------------------------|
| Temperature—superficial | 97° | 95.5° |
| deep | 96.5° | 97° |
| Blood pressure | 70 mm. | 60 mm. |
| Blood volume flow—1 minute | 45 c.cm. | 17 c.cm. |
| Blood volume flow—1 minute | 34 c.cm. | 11 c.cm. |

Determinations repeated November 14, 1932 (8 months)

| Distal femoral artery now pulsating | Left Sympathetic tonized | Right Unsympathetic tonized |
|-------------------------------------|--------------------------|-----------------------------|
| Temperature—superficial | 93.0° | 91.0° |
| deep | 92.5° | 91.0° |
| Blood pressure | 80 mm. | 60 mm. |
| Blood volume flow—1 minute | 120 c.cm. | 78 c.cm. |
| Blood volume flow—1 minute | 134 c.cm. | 65 c.cm. |
| Blood volume flow—1 minute | 138 c.cm. | 66 c.cm. |

Cutaneous and deep circulatory changes Correlation of the collateral arteriole circulatory changes following sympathectomy with the skin capillary temperature findings. In creased circulation through the collateral arterioles constantly followed adequate lumbar sympathetic neurectomy. In these same animals the cutaneous temperature findings as evidence primarily of capillary circulation were inconstant and variable. Frequently elevation of one degree or two degrees in skin

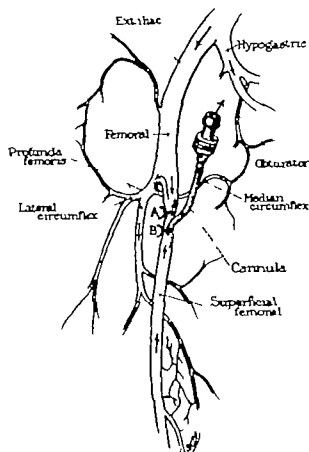


Fig. 1. Method of obtaining actual blood flow and direct blood pressure of the collateral arteriole circulation. The superficial femoral artery is cannulized distal to the ligature. Blood appearing in the cannula must circulate through the collateral vessels around the obstructed main artery.

temperature after sympathectomy was associated with as much as 50 to 100 per cent increase in actual arteriole circulation. Furthermore the elevated skin temperature may quickly disappear or even become lower than on the opposite control side.

Dog 90, left lumbar sympathectomy performed September 8 1932

| Immediately following sympathectomy | Left Sympathetic tonized | Right Unsympathetic tonized |
|-------------------------------------|--------------------------|-----------------------------|
| Temperature—superficial | 96.0° | 91.0° |
| deep | | |
| Two months later November 11, 1932 | | |
| Temperature—superficial | 93.0° | 91.0° |
| deep | 92.0° | 91.0° |
| Blood volume flow—1 minute | 30 c.cm. | 1 c.cm. |
| Blood volume flow—1 minute | 31.5 c.cm. | 2 c.cm. |
| Blood volume flow—1 minute | 30 c.cm. | 27 c.cm. |
| Blood pressure | 80 mm. | 60 mm. |

RESULTS OF EXPERIMENTS

The collateral arteriole circulation in experimental animals is markedly uniform in the right and left hind legs. A gradual but steady increase in peripheral circulation takes place

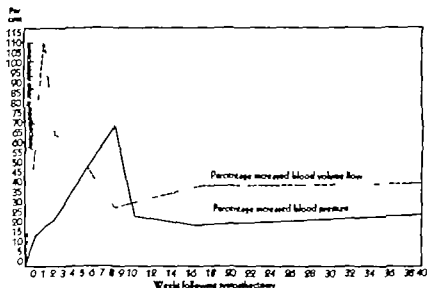


Fig. 3. Percentage increase in average blood volume flow and average blood pressure of the arteriole circulation at week intervals following left lumbar sympathectomy. There is no relationship between increased blood flow and change in blood pressure. The average blood flow is tremendously increased immediately and within the first 8 weeks following sympathectomy. During this time the average blood pressure shows a gradual rise, reaching its maximum 8 weeks after denervation at which time the increase of the average flow on the sympathectomized and unsympathectomized arteriole circulation becomes stabilized.

over a period of weeks and months as a normal physiological response to main artery occlusion. Adequate sympathetic neurectomy of the vasoconstrictor control is followed by an immediate marked increase in collateral circulation. This increase remains constantly greater than the physiological increase taking place in the unsympathectomized leg (Fig. 3).

Blood pressure readings of the arteriole circulation in the right and left legs are as uniform as the blood volume flow. Only slight increase in blood pressure is recorded after sympathectomy but this remains constantly higher than in the unsympathectomized leg. The direct blood pressure in the arterioles eventually (10 months) reaches the systemic level which was present before occluding the main artery. Although the pressure in the unsympathectomized limb steadily increases after occlusion of the main artery it is constantly lower than the corresponding findings on the sympathectomized side (Fig. 4).

The cutaneous temperature readings are in constant both on the sympathectomized and unsympathectomized limb. As a rule, the skin temperature immediately following denerva-

tion is 1 to 2 degrees higher than on the control limb. This may soon disappear and become even less than on the unsympathectomized limb. Although the skin temperature may be variable, the blood volume flow and blood pressure in the arteriole circulation is markedly uniformly increased following sympathectomy.

DISCUSSION

In animal investigation superficial skin temperature changes have been largely depended upon to confirm and clarify clinical observations as to the effect of sympathetic neurectomy on the peripheral circulation. For the most part the results have not substantiated the clinical enthusiasm for the operative procedure. McCullagh (31) found that recovery of cutaneous vascular control is more complete and more rapidly effected after sympathectomy on laboratory animals than on man. Furthermore, Oughterson and Harvey (36) before the American Surgical Association reported that from 4 to 6 weeks after sympathectomy the skin temperature of the sympathectomized limb was essentially the same as of the unsympathectomized limb.

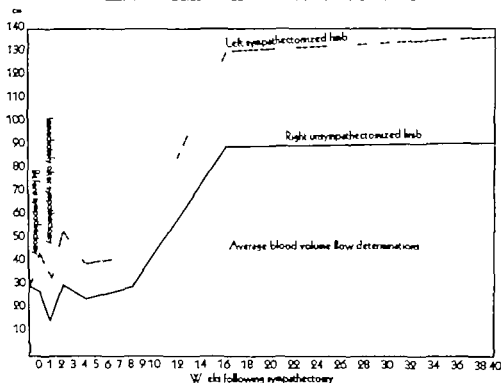


Fig. 3. Average blood volume flow per minute on the right and left legs before, immediately and at week intervals following left lumbar sympathectomy. The actual blood flow on the left sympathectomized leg was constantly greater than on the right unsympathectomized side.

They explain the variation in results obtained by sympathectomy as due to our lack of knowledge of the exact course pursued by these fibers and particularly the levels at which they leave the spinal cord. However the inconstant and variable skin temperature findings following sympathectomy on my first series of 50 dogs could not be explained by autopsy findings of inadequate denervation. In analyzing the results of our experiments the conclusion is reached that skin temperature findings alone could not be used as an index of the effect of the sympathectomy on the peripheral circulation on experimental animals.

The body surface temperature is primarily influenced by the peripheral capillary circulation. These capillaries react to both peripheral stimuli and central sympathetic influences (22). Sympathectomy removes the central sympathetic vasoconstrictor control of the capillaries. Sheard (15) studied the peripheral vasomotor capillary reaction following sympathectomy with rapidly changing environmental temperatures. Capillary vasoconstriction was found to be diminished but vasodilatation remained practically the same

as in the unsympathectomized limb. These peripheral capillary reflexes, independent of central control, make the use of skin temperature findings unreliable as a basis for studying the effect of sympathectomy upon the peripheral circulation. The presence of small Rouget cells within the capillary wall may be responsible for these peripheral reflexes (24). Jelliffe (23) believes that these ganglion cells are capable of producing reflexes exactly as occurs in all skin and tendon reflexes from terminal stimuli. The fact that skin temperature changes following adequate sympathectomy in experimental animals are inconstant and variable indicates independent peripheral vasomotor reflexes (Kuntz).

Ligation of the main artery of a lower extremity in experimental animals produces a definitely diminished peripheral circulation. Distal to the obstruction the pulse immediately becomes imperceptible and a definite fall in temperature of the limb is recorded. Complete cessation of peripheral circulation is prevented by collateral arteriole anastomoses around the obstructed artery. The adequacy of the initial collateral circulation in dogs was demonstrated by more than 250

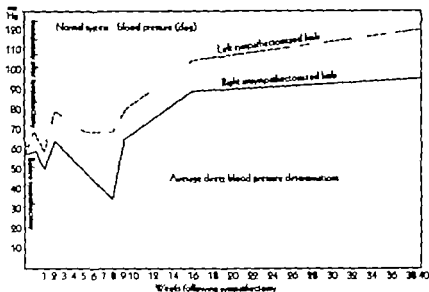


Fig. 4. Average direct blood pressure findings of the arteriole circulation on the left sympathectomized and right unsympathectomized extremities. Before denervation operation the average findings on the right and left sides were constantly uniform (58 mm.). Following sympathectomy the blood pressure on the left sympathectomized limb was constantly higher than on the right unsympathectomized leg. Within 4 to 5 months the pressure of the collateral circulation on the sympathectomized side reached the normal systemic level (110 mm.). The pressure on the right unsympathectomized collateral circulation remained below the systemic level even after 10 months of observation.

femoral artery ligations. Evidence of necrosis or gangrene did not occur in any of the limbs. Gradual improvement in the arteriole circulation follows with a moderate but incomplete return of peripheral pulsation and rise in temperature. The extent of collateral anastomoses is readily demonstrated by roentgenograms (43) of arterial trees in both animal and non-gangrenous human limbs. Where gangrene supervened in human limbs collateral arterioles are either very small or completely absent.

Arteriospasm or hypervasoconstriction of the arterioles in clinical cases exerts a profound influence in increasing the peripheral circulatory deficiency due to main artery obstruction (7 to 35 39). This cannot be duplicated in experimental animals. Consequently there will be a proportionately less marked subnormal peripheral temperature in animals than is found in humans with main artery occlusion. Relief of arteriospasm by sympathetic neurectomy will in itself provide increased peripheral circulation. However an actual vasodilatation of the arterioles beyond

their normal tone does not necessarily follow from clinical observation.

The effect of lumbar sympathectomy on the circulation of the unobstructed femoral artery on dogs was recently reported by Herrick (21). Using a specially devised instrument, the thermostromuhr the temperature changes were recorded and used to calculate the blood flow through the vessel. Following sympathectomy the flow under local anaesthesia, was almost doubled indicating a definite dilatation of the unobstructed artery. Increased circulation through the femoral artery following lumbar sympathetic neurectomy demonstrates that the main artery to an extremity is normally under constant vasoconstrictor sympathetic influence.

Arteriole anastomoses are the principal channels of collateral circulation when the main artery to an extremity is obstructed. For clinical application animal investigation of the effect of sympathectomy should be concerned with vasodilatation of these vessels. By means of a capillary microscope Brown (11) found that skin capillaries following symp

thectomy appeared 50 per cent smaller in size but more numerous. The increased skin temperature following denervation is interpreted as due to dilatation of the arterioles. He concludes, indirectly, that sympathectomy "exerts its greatest influence on the arterioles." However, as far as I have been able to find no direct experimental evidence of sympathetic control of arteriole circulation has been reported.

COMMENT

Adequate collateral arteriole circulation in obstructive arterial disease of an extremity is essential in maintaining the vitality of the limb. Various procedures have been recommended to improve the peripheral circulation. Among these penarterial sympathectomy (4, 14, 26, 27, 32), artery ligation (28) or artery and vein ligation (8, 43), pervertebral sympathetic ganglionectomy, ramisectomy or neurectomy (17), roentgen ray exposure (37) of the vessels of the limb or pervertebral ganglia, physiotherapy (15), hydrotherapy (15) and vaccine therapy (2, 3, 5, 6) have been the most popular. For the most part clinical and animal experimental investigation has failed to confirm the results which were originally reported.

Frequent and numerous clinical reports as to the beneficial effect of sympathetic neurectomy in obstructive arterial disease of the extremities emphasize the importance of properly selecting cases for operation. Adson (30), Filatov (20) and others report improved peripheral circulation following sympathectomy in a series of cases over a five year period. This can be considered permanent.

The results of animal experiments here reported confirm Brown's clinical observation and interpretations. The arteriole circulation is constantly and permanently increased following sympathectomy. If this increase were due entirely to vasodilatation of the arterioles according to the method of the experiments the maximum increase in arteriole blood pressure would accompany a maximum increase in blood volume flow. This was not found to be so. In addition to a dilatation of the existing arterioles an increased number of new anastomoses must have opened to form new channels of collateral circulation.

SUMMARY AND CONCLUSIONS

The results of 260 experiments on blood volume flow, direct blood pressure and temperature findings on 110 dogs are the basis of this report.

Ligation of the femoral artery in dogs did not produce peripheral necrosis or gangrene. Although a definite decrease in peripheral circulation occurred, adequate collateral arteriole circulation maintained the limb's vitality.

Normally physiological improvement in the arteriole circulation follows main artery occlusion. Gradual but incomplete return of peripheral arterial pulsation and rise in temperature of the limb are evidence of improved collateral arteriole circulation.

Inconstant and variable cutaneous temperature readings on 50 sympathectomized animals could not be explained by autopsy findings of inadequate denervation.

Immediate and permanently increased collateral arteriole circulation follows adequate lumbar sympathectomy on experimental animals in cases of peripheral circulatory deficiency due to main artery occlusion.

Increased cutaneous temperature findings following sympathectomy does not indicate vasodilatation of all the peripheral circulatory channels. Vasodilatation and increased number of collateral arteriole anastomoses accounts for the improved peripheral circulation and indirectly for the increase in skin temperature.

Peripheral cutaneous capillary reflexes independent of sympathetic control are probably responsible for most of the inconstant and variable skin temperature findings.

The results here reported have definite clinical applications. Where functionally active collateral arterioles of the extremities exist, appropriate sympathetic neurectomy produces an immediate and permanently increased peripheral circulation. The procedure should be of great value also in cases of impending peripheral gangrene due to sudden traumatic or operative occlusion of the main artery.

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INTRA-ABDOMINAL PRESSURES CREATED BY VOLUNTARY MUSCULAR EFFORT

II. RELATION TO POSTURE IN LABOR

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IN the preceding communication, a method was described for measuring intra-abdominal pressures created by voluntary muscular effort.¹ Thus with an air inflated balloon in the vagina, connected to a mercury manometer, a satisfactory estimate of pressure was obtained.

During the development of the method, it became evident that the pressure which a woman could create depended to a certain degree upon posture. This observation suggested the use of the method as a means for measuring the efficiency of postures commonly employed in labor.

A considerable literature has appeared on posture in labor. From time to time, various postures have been advocated as most efficient on the basis of clinical observations but no quantitative measurement of the relative efficiency of different postures has been described. The present report deals with the measurement of such postural relationships.

MATERIALS AND METHODS

Measurements were made upon 5 healthy women who exhibited no symptoms or signs of pelvic disease at the time that testing was begun. One of them, M F had had an appendectomy 16 years, and a right oophorectomy and partial left oophorectomy 11 years previously. None of the others had been subjected to any abdominal operation. Further description of the subjects is given in Table I.

The method of measuring intra abdominal pressures is described in detail in the first paper of this series. The postures employed in the present study are illustrated in Figure 1.

In order to confine the straining efforts to the use of the abdominal muscles alone, as far as that was possible pulling with the hands and arms was not permitted.

Two sets of measurements were made on each individual in each posture (A) the maximum intra abdominal pressure which could be created on straining and (B) the weight effect of the viscera upon the vaginal balloon.

RESULTS

A Maximum pressures created on straining
A total of 1,167 tests each representing a maximum straining effort was made upon the 5 women. The results are summarized in Table II. They are arranged according to the averages (weighted) of the intra abdominal pressures recorded for each posture the lowest average being found in the lateral prone and the highest in the sitting posture.

It will be seen that beyond a general grouping of low averages for postures with the torso horizontal and high averages for those with the torso vertical, nothing significant in the relationships among the postures appears in this table.

The measurements in this table and throughout the paper are expressed in centimeters of mercury (cm Hg). It should be remembered that the method employed of estimating intra abdominal pressures created by straining gives a reading which is too large by 0.7 centimeter of mercury and that this increase is due to the elasticity of the rubber balloon. No correction has been made for this increase because we are concerned with relative postural efficiency and the same error enters into all measurements.

In order to ascertain how well the pressures created by each individual conformed to the average pressures for the group the individual average pressures were ranked in order of efficiency from 1 to 7, beginning with the lowest (Table III). From these rankings, an average rank was obtained. By means of the rank order correlation formula, the posture ranking of each subject is compared with the average obtained for all. A grade of 60 per cent

¹Murphy, D. P. and Mengert, W. F. Intra-abdominal pressures created by voluntary muscular effort. I. Technique of measurement by vaginal balloon. *Burg. Gynec. & Obst.*, 1923, 14, 487-503.

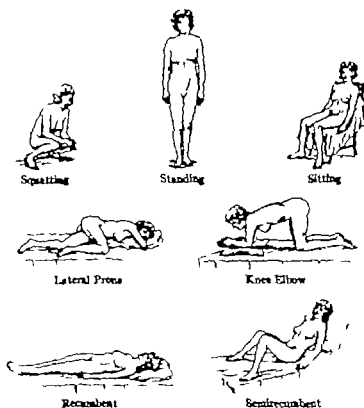


Fig. Postures employed in studying the effect of posture on maximum intra-abdominal pressures which can be created by voluntary muscular effort.

or more is assumed to indicate fair correlation. Thus it will be seen that despite variations in posture order among the subjects there is nevertheless a definite trend toward uniformity.

Finally each posture was compared with every other one. The difference between the weighted averages of any two postures, taken from Table II, was compared with three times its standard error. The result of this comparison of each posture with the remaining ones is

recorded graphically in Figure 2. Significant differences between postures are expressed with a plus sign; insignificant differences with a minus sign.

B. Weight effect of viscera. A total of 27 sets of readings was made of the effect of the weight of the viscera upon the inflated vaginal balloon when each subject was *not straining*. A set of readings represented one test in each posture and was obtained in the following manner. The balloon was inflated with a pressure of approximately 4.0 centimeters of mercury the subject standing and a reading made. The subject then assumed the remaining postures and a reading was made in each without altering the original balloon inflation. The results are shown in Table IV. In order to indicate the *relative* visceral weight effect in each posture the lowest reading which occurred in knee-elbow in all 5 subjects, was subtracted from each of the seven readings.

TABLE I.—DESCRIPTION OF SUBJECTS

| Identical-Case | Age | Height cm. | Weight kgm. | Abdominal circumference cm. | Pregnancy No. |
|----------------|-----|------------|-------------|-----------------------------|---------------|
| M.F. | 25 | 166 | 61.6 | 76.5 | |
| A.E. | 3 | 155.6 | 36.9 | 66 | 5 |
| M.M. | 9 | 96 | 17.4 | 72.7 | |
| R.M. | 27 | 144.8 | 30 | 66.3 | 3 |
| A.W. | 5 | 148 | 25 | 71.1 | 4 |

TABLE II.—MAXIMUM INTRA ABDOMINAL PRESSURES CREATED ON STRAINING

Summary of measurements of intra-abdominal pressures created by 5 healthy non-pregnant women when straining their maximum in each of seven postures. Note (1) order of postures, which is determined by the weighted averages, and (2) that postures with the torso vertical have the higher averages.

| Posture | M.F. | | | | A.K. | | | | M.M. | | | | R.M. | | | | A.W. | | | | Total tests | Weighted average cm. Hg. | Standard error of average cm. Hg. | |
|-----------------|-----------------|--------------------|--------------------|--------------------|-----------------|--------------------|--------------------|--------------------|-----------------|--------------------|--------------------|--------------------|-----------------|--------------------|--------------------|--------------------|-----------------|--------------------|--------------------|--------------------|-------------|-----------------------------|--------------------------------------|--------|
| | Tests number | Minimum cm. Hg. | Maximum cm. Hg. | Average cm. Hg. | Tests number | Minimum cm. Hg. | Maximum cm. Hg. | Average cm. Hg. | Tests number | Minimum cm. Hg. | Maximum cm. Hg. | Average cm. Hg. | Tests number | Minimum cm. Hg. | Maximum cm. Hg. | Average cm. Hg. | Tests number | Minimum cm. Hg. | Maximum cm. Hg. | Average cm. Hg. | | | | |
| Lateral prone | 25 | 7 | | 8.5 | 25 | 8.5 | 5.3 | 6 | 34 | 1.1 | 2.8 | 5 | 23 | 7.4 | 14.8 | 10.0 | 5 | 0.2 | 13.7 | 3 | 124 | 11.8 | ± 0.27 | |
| Reclumbent | 5 | 0 | 2.0 | 0.7 | 120 | 0 | 17.8 | 4 | 41 | 8.8 | | 14.3 | 5 | 0 | 17.8 | 7 | 25 | 11.2 | 7.0 | 13.9 | | 8.0 | 7 ± 0.5 | |
| Knee elbow | 5 | 7 | 10 | 0.5 | 5 | 0 | 6.4 | 13.8 | 30 | 3.0 | 31.2 | 6.8 | 25 | 0.8 | 9.5 | 14.7 | 25 | 0 | 17.6 | 14.0 | | 130 | 13.4 | ± 0.20 |
| Semi-reclumbent | 25 | 0 | 12.8 | 11 | 5 | 13.0 | 10.5 | 6.3 | 35 | 13.3 | | 6.7 | 25 | 0 | 16.8 | 16.8 | 5 | 12.6 | 8.1 | 11.6 | | 85 | 13.6 | ± |
| Squatting | 25 | 10 | 13.4 | | 25 | 11.3 | 0.8 | 14.6 | 28 | 1 | 0.5 | 18.1 | 5 | 8.1 | 6.3 | 4 | 25 | 0 | 13.8 | 5 | 128 | 14.3 | ± 0.20 | |
| Standing | 5 | 1 | 24.4 | 0 | 46 | 8 | 40 | 14.3 | 49 | 0 | 22.8 | 15.7 | 5 | 13 | 9 | 13.4 | 5 | 11.2 | 14.6 | 15.5 | | 70 | 14.5 | ± 0.20 |
| Sitting | 5 | 0 | 8 | 11.8 | 25 | 13 | 21 | 0 | 17.0 | 43 | 12.8 | 25.3 | 6 | 25 | 13.4 | 17.7 | 15.9 | 74 | 18 | 9.8 | 5 | 94 | 15.4 | ± 0.20 |
| Total tests | 25 | | | 20 | | | | | 5 | | | | 275 | | | | 224 | | | | 1167 | | | |

*Basic inflation pressure of balloon 2 centimeters of mercury; all others approximately 4.0 centimeters of mercury

By this treatment of the figures, the visceral weights are given as differences with the lowest ranking posture—knee-elbow—expressed as zero. The effect of visceral weight upon the vaginal balloon was fairly constant from subject to subject—as indicated by the standard errors of the averages for each posture. This

was to be expected since we were dealing with a purely physical phenomenon.

In the knee-elbow posture, the viscera gravitate cranially, this occurs but in lesser degree, in the lateral prone posture. As the torso becomes more nearly vertical the weight effect of the viscera becomes greater—being greatest

TABLE III.—MAXIMUM INTRA ABDOMINAL PRESSURES CREATED ON STRAINING, CORRELATION OF INDIVIDUAL WITH AVERAGE POSTURAL RANK

Postures are ranked in order of efficiency; the lowest being given a value of one. Rankings based on data in Table II. Note that the posture ranking of each patient compares favorably (better than 60 per cent) with the average rank of the group

| Posture | M.F. | A.K. | M.M. | R.M. | A.W. | Average rank |
|--|------|------|------|------|------|--------------|
| Lateral prone | | | | 1 | 2 | 1.4 |
| Reclumbent | 3 | 3 | | | 4 | 6 |
| Knee-elbow | | | 5 | 5 | 5 | 5.8 |
| Semi-reclumbent | 4 | 6 | 4 | 3 | 6 | 4.6 |
| Squatting | 6 | 5 | 7 | 4 | | 4.6 |
| Standing | 7 | 4 | 3 | 6 | 3 | 4.6 |
| Sitting | 5 | 7 | 6 | 7 | 7 | 6.4 |
| Correlation with average rank, percent | 70 | 85 | 76 | 87 | 61 | |

Best effort not put forth. A mild intercurrent disease was probably responsible.

TABLE IV.—EFFECT OF VISCERAL WEIGHT ON VAGINAL BALLOON

Summary of average differences among pressures exerted upon the vaginal balloon by weight of abdominal viscera, subjects *not* straining. Differences were obtained by subtracting figures recorded for knee-elbow posture (lowest for each subject) from those obtained for all the postures, thus giving knee-elbow a value of zero. Note that the weight of the viscera becomes progressively more effective as the torso approaches the vertical.

| Sets of readings | Average differences | | | | | Weighted averages | Standard error of averages |
|------------------|---------------------|---------|---------|---------|---------|-------------------|----------------------------|
| | M.F. | A.K. | M.M. | R.M. | A.W. | | |
| Postures | cm. Hg. | cm. Hg. | cm. Hg. | cm. Hg. | cm. Hg. | cm. Hg. | cm. Hg. |
| Knee-elbow | 0 | 0 | 0.0 | 0 | | 0 | ± 0.00 |
| Lateral prone | 0.4 | .4 | 0.8 | 6 | 0.4 | 0.5 | ± 0.04 |
| Reclumbent | 3 | 1 | 1 | 1.3 | 3 | 1 | ± 0.06 |
| Squatting | 8 | 3.5 | 9 | 1 | 8 | 1.8 | ± 0.08 |
| Semi-reclumbent | 1.8 | 2.3 | 1.7 | 1 | 1.8 | 2.1 | ± 0.07 |
| Standing | 1.7 | 1.9 | 3 | 2.3 | 7 | 1 | ± 0.07 |
| Sitting | 8 | 2.3 | 2.4 | 2.7 | 2.8 | 4 | ± 0.07 |

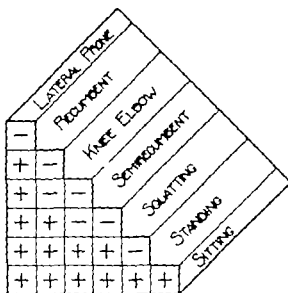


Fig. 2. Correlation of postural differences among the average pressures produced by maximum straining effort. Diagram showing whether or not a significant difference existed between the weighted average pressures of any two postures. The postures are arranged in ascending order of efficiency beginning with the least efficient, lateral prone. Plus represents a *significant*, and minus an *insignificant* difference. For example, knee elbow (reading to the left) does not exhibit a significant difference from recumbent but does show such a difference from lateral prone. Reading down, knee-elbow shows no significant differences from semirecumbent and squatting but does exhibit such differences from standing and sitting. From this diagram, it is possible to ascertain whether or not any posture or group of postures is more efficient than any other posture or group of postures.

in sitting posture. Here there is not only a maximum effect due to gravity but also probably some compression of the abdominal viscera by the contents of the thorax.

MAXIMUM PRESSURES CREATED ON STRAINING LESS WEIGHT EFFECT OF VISCERA

The weighted averages of pressures created by straining (taken from Table II) are given in Table V column 1. The average for lateral prone was subtracted from each of the seven averages in a manner similar to the treatment of the visceral weight averages thus expressing the weighted averages as differences (column 2). The corresponding visceral weights (taken from Table IV) are recorded in column 3 and the result of subtracting them algebraically from the straining differences (column 2) is shown in column 4.

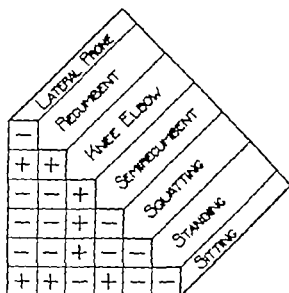


Fig. 3. Correlations of postural differences among the average pressures produced by maximum straining effort after subtracting visceral weight effect. Compare with Figure 2. Note that significant differences from other postures occur only in knee-elbow and sitting.

Two postures, knee-elbow and sitting show relatively large differences as a result of this subtraction and these differences are significant, being greater than three times their standard errors (column 5). The 5 remaining postures show insignificant differences between the effect due to straining and the effect of visceral weight.

In other words, on the basis of our observations, there are no significant differences in the pressures created by muscular effort in five of the postures which cannot be explained on a simple basis of visceral weight. Knee-elbow and sitting postures, however, have differences too large to explain on that basis alone.

With the visceral weight factor eliminated, the postures are compared with one another in Figure 3 as was done without deduction of the visceral weight factor in Figure 2. It will be seen in Figure 3 that there are no significant differences among the postures except in the cases of knee-elbow and sitting.

DISCUSSION

A series of 5 women is admittedly a small one from which to draw conclusions. From Table III, however, we see that the posture

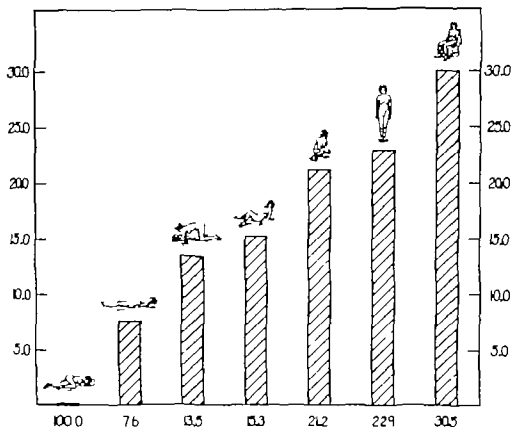


Fig. 4. Postural efficiency in percentages lateral prone given as 100. Showing the percentage efficiency of the seven postures on the basis that the least efficient (lateral prone) has a value of 100. Note (1) posture efficiency tends to increase as the body approaches the vertical (2) posture order does not conform to expectation on the basis that visceral weight is the only factor because knee-elbow and sitting constitute exceptions to this general trend.

order of each of the women has a satisfactory agreement with that of the average order of the group. Also, calculation of the standard errors of the weighted averages (Table II) shows that even the most variable averages (knee-elbow 13.4 centimeters of mercury and squatting 14.3 centimeters of mercury) are not subject to a variation greater than ± 0.29 centimeters of mercury.

None of the 5 subjects was pregnant. Consequently, our observations must be interpreted in the light of this fact and must not be applied unreservedly to straining ability in the second stage of labor.

The lateral prone posture gives an average reading of 11.8 centimeters of mercury. This represents a pressure of 160.5 grams per square centimeter (2.28 pounds per square inch). The sitting posture gives an average reading of 15.4 centimeters of mercury, which represents 209.5 grams per square centimeter (2.98 pounds per square inch). In other words, a woman

sitting in a chair can exert an average intra abdominal pressure of 49.0 grams per square centimeter (0.70 pounds per square inch) more than she can when lying on her side. Figure 4 is a graphic arrangement of postural efficiency and is given in percentage of increased efficiency which each posture has over lateral prone. It may be seen that the difference of 49.0 grams per square centimeter (0.70 pounds per square inch) between the efficiency of sitting and lateral prone postures represents a 30.5 per cent increase in straining efficiency in favor of sitting. To what is this increase due? Is it entirely a matter of visceral weight or are the abdominal muscles able to contract with greater advantage in certain postures?

Though we had no satisfactory method for measuring absolute visceral weight in each posture we could measure relative weight from posture to posture. When this was done it was found that the order of posture alignment on a visceral weight basis followed theoretical

TABLE V—MAXIMUM PRESSURES CREATED ON STRAINING LESS WEIGHT EFFECT OF VISCERA

The result of subtracting the visceral weight effect from the straining effect is shown.

| Column number | | | 3 | 4 | 5 |
|---------------|------------------|--|-------------------------|--|---|
| Description | Weighted average | Average column expressed as difference | Visceral weight average | Strained difference from visceral weight | 3 standard errors of difference of column 4 |
| Posture | From Table II | Lateral prone subtracted from each average | From Table IV | Column minus column 3 | |
| | cm. Hg. | cm. Hg. | cm. Hg. | cm. Hg. | cm. Hg. |
| Lateral prone | | | | → 5 | |
| Recumbent | 7 | 8 | | → 0 | 20 |
| Knee-elbow | 14 | 6 | | +16 | 27 |
| Semirecumbent | 6 | 8 | | → 1 | 1 |
| Squatting | 14.3 | 1 | 8 | +0.7 | 90 |
| Standing | 14.3 | 7 | | +0.8 | 61 |
| Sitting | 14 | 16 | 4 | +1.2 | 20 |

Note (column 4) that the resulting differences in the cases of knee-elbow and sitting postures stand out from the remaining five, thus demonstrating that these two postures have an efficiency that cannot be explained on the effect of visceral weight alone.

expectation very closely. It will be remembered that the knee-elbow posture was *lowest* in this series, but that it occupied the *third* place in the straining series. In the latter the pressure difference between lateral prone and sitting was given as 49.4 grams per square centimeter (0.70 pound per square inch) whereas, visceral weight alone was responsible for 27.2 grams per square centimeter (0.39 pound per square inch) of the difference. In other words the visceral weight effect is responsible for 54.7 per cent and increased muscular efficiency for 47.3 per cent of the total efficiency increase of sitting over lateral prone.

It will be remembered (Table V) that differences in straining efficiency among five of the postures, lateral prone, recumbent, semi-recumbent, squatting and standing were due entirely to the gravitational effect of the viscera. Two postures, knee-elbow and sitting, however, exhibited significant differences in straining efficiency which could not be explained on a purely visceral weight basis. In other words, not only does visceral weight play a rôle in differentiating these postures from the others, but also there must be some mechanical advantage of muscular action in the knee-elbow and sitting postures. We will not attempt to offer an explanation of the increased efficiency of muscular action in these postures, being content merely to point out that such a difference in efficiency exists. Both

of these postures have been employed extensively in animal and human obstetrics. A posture similar to the knee-elbow—in that the angle of the body with the horizontal and the angle of the limbs with the body—is used by all quadrupeds in labor while sitting is the time honored position assumed in the obstetric chair. Undoubtedly the obstetric chair was abandoned because of the greater readiness with which examinations and obstetrical operations could be carried out with the patient in the recumbent posture. This change probably occurred at about the time of the "obstetrical revolution" when the forceps was introduced into obstetrics.² Do the advantages to the obstetrician of having the patient in the recumbent posture outweigh the disadvantages to her? This question cannot be answered dogmatically. Even on the basis of our data we do not advocate, unreservedly, a return to the obstetric chair for delivery. We have shown, however, that five non-pregnant women created 30.5 per cent more intra-abdominal pressure when in the sitting than when in the lateral prone posture, and that this 30.5 per cent increment was composed of two factors (A) full force of visceral weight (B) increased efficiency of muscular contraction.

We feel that the results of this quantitative evaluation of postural efficiency suggest a

²McGarity, W. F. The origin of the male midwife. *Ann. Med. Hist.* 1934, 1, 77, 417-464.

more liberal use of the sitting posture during the second stage whenever it is desired to expedite labor

SUMMARY AND CONCLUSIONS

The influence of posture upon the maximum intra-abdominal pressure which could be created by straining was studied on 5 healthy non-pregnant women by means of the vaginal balloon technique previously developed

Two sets of measurements were made (B) 1167 separate observations, each recording actual intra abdominal pressure at the height of a maximum straining effort were made of the 5 women when in each of seven postures. These were lateral prone recumbent, knee elbow, semirecumbent squatting standing and sitting (B) Twenty-seven sets of seven readings each were made of the relative effect of visceral weight from posture to posture. In this series of tests the women were *not* straining. It was found

1 That the 5 subjects could create pressures averaging 49.0 grams per square centimeter (0.7 pound per square inch) *more* when sitting than when lying in a left lateral prone (Sim's) position. This represents a 30.5 per cent increase in straining efficiency

2 This increase was made up of two components (a) weight of viscera (b) increased advantage of muscular action

3 Five of the postures, lateral prone recumbent, semirecumbent squatting and standing had only one of these components (visceral weight) and did not seem to possess any increased efficiency of muscular contraction. In other words any differences among them depended solely on an increase in effective visceral weight as the torso approached the vertical

4 In two of the postures knee-elbow and sitting the subjects were able to use their abdominal muscles to greater advantage. Thus in sitting visceral weight accounted for 26.8 grams per square centimeter (0.37 pound per square inch) of the 49.0 grams per square centimeter (0.7 pound per square inch) advantage which this posture possessed over lateral prone. This represented slightly more than half of the increased efficiency of this posture. The remainder must have been increased efficiency of muscular action

5 These observations suggest a more liberal use of the sitting posture during the second stage whenever it is desired to expedite labor

Acknowledgment is made to Dr H. C. Bazett, professor of physiology, for his interest and advice during the period of investigation

The authors are also indebted to assistant professor J. P. Burk, of the Wharton School of Finance and Commerce, for advice on the statistical calculations necessary to the preparation of our data.

THE ASEPTIC PERITONEAL CAVITY—A MISNOMER¹

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WE are taught to believe that in normalcy the peritoneal cavity is sterile. Our bacterial studies of the peritoneal fluid led us to believe that this is not true.

In 1928 we began a study of peritonitis. We decided to confine this work to the phenomenon as it occurred in human beings, feeling that only from such a study could we learn anything which would eventually aid the clinician.

The bacteriology of the disease seemed so highly confused that we elected to begin our research problem from this standpoint. At once it was apparent that to obtain data for such a study we had best see what happened when we took cultures from peritoneal cavities which presented none of the clinical manifestations of peritonitis and compare the results of these cultures with those taken from peritoneal cavities which showed recognizable manifestations of intraperitoneal inflammatory reaction.

Much to our surprise cultures obtained from the peritoneal cavities of patients operated upon for such conditions as fibroids, hernie, interval appendicitis, and retroversion under the conditions of operating room technique then in vogue showed a ready growth of organisms.

Such results were very surprising. Up to that time we had shared with the bulk of the profession the current belief that cultures from the peritoneal cavity of a normal individual if opened under aseptic conditions would show no growth. We at once attributed the positive cultures to contamination due to operative technique.

To ascertain at what point this contamination occurred, we began to take cultures from the skin after preparation and of the knife blades used to make the skin incision.

Although we were using a per cent iodine in alcohol and alcohol after cleansing the skin with ether surface cultures were found to be

persistently positive. As a result the skin antiseptic known as MBGV 5 and reported upon by the senior author in 1928 was evolved. By the use of this method of pre-operative skin preparation we were sure that our skin surface was sterile. Persistent positive cultures from the skin knife blades were still obtained. They could be explained by one of two theories: (1) the bacteria were air borne; (2) the bacteria were in the tissues between the skin surface and the external oblique aponeurosis.

Since it is obviously impossible to eliminate air borne contamination entirely the only way by which it can be proved irrelevant is to show that the flora obtained from cultures of operating room air during operation is different from the flora obtained from cultures taken from the body below the level of the skin surface. In investigating possible sites of contamination we have done cultural work on the air skin and deep skin layers.

We will present the results of our experiments in such order that they can most readily be understood the order of presentation being: (1) bacteria of the air; (2) bacteria of the skin surface; (3) bacteria of deep skin layers; (4) bacteria of the peritoneal cavity in cases both with and without intra-abdominal inflammatory reaction.

BACTERIOLOGICAL TECHNIQUE

Before we present these figures, we wish to say a word concerning the methods used and to call attention to the fact that we have tried to keep our results in as simple a form as is consistent with accuracy. We decided to use the classification recommended by Bergey which has been tentatively accepted by the Society of American Bacteriologists and have classified all organisms according to it except in the case of the streptococci which are differentiated according to the more satisfactory system of Holman. In many of the cultures yielding more than one species of

organism we did not attempt identification beyond tribe or genus. Many bacteria were found which were unidentifiable beyond the heading of genus because of variations in morphology or cultural characteristics. Therefore, no attempt has been made to subdivide all the genera into species. Some bacteria seen in smear were not identified at all.

We also wish to call attention to the fact that we do not make any statements as to the pathogenicity of the organisms identified, as we believe that this is such a moot question and involves so many highly technical problems it is beyond the scope of the present presentation.

Various media and procedures were used during the 3 years of this study. The following method proved most satisfactory and practicable. It was used in the majority of peritoneal cultures. Obvious departures for different tissues are indicated in the text.

Swabs. Swabs are placed in large plugged test tubes wrapped in a towel—sterilized in a hot air oven and then autoclaved.

Technician. The technician is scrubbed, gowned and gloved as for an operation.

Taking cultures. The peritoneum is lifted and incised with a carbolized knife. Each swab is saturated with peritoneal fluid and quickly replaced in the test tube. Cultures of general peritoneal fluid were taken as soon as the peritoneum was incised. Cultures obtained from the serosa of inflamed organs were taken as soon as the organ was identified.

Bacteriological methods. The swabs were taken to the laboratory immediately. The fluid on each swab was rinsed off into aerobic (plain beef infusion broth pH 7.6) and anaerobic (preheated glucose liver broth) media. A smear of each swab was made and the swab discarded. These smears were stained with gram stain, and the morphology and staining properties of any bacteria in the smear were noted. The anaerobic media was sealed with one half inch of a mixture of one part paraffin to one part vaseline.

The inoculated tubes were incubated at 37 degrees C., for from 24 hours to 3 weeks depending on the (1) presence or absence of bacteria in original smear (2) morphology of

bacteria in original smear, (3) the period of time required for evidence of growth (4) the amount of bacterial growth. When there were no bacteria in the original smear and no evidence of growth the inoculated tubes were incubated for 3 weeks, then smears made and examined, before a report of "no growth" was made.

The bacteria that grew were

1 Streaked on 5 per cent rabbit blood agar plates for color and reaction on blood of aerobes

2 Heated to 80 degrees C for 20 minutes to isolate *spore bearers*. The heated culture was (a) streaked on plain agar for aerobes (b) put in preheated glucose liver broth litmus milk, and gelatin sealed—for anaerobes

The smears were checked to determine whether or not the organisms isolated by these procedures represented all the types seen in smears. Special procedures enrichment etc were used to try to get forms seen in smear but which were either anaerobic non-spore bearers or had been overgrown by associated organisms.

The isolated bacteria were put on whichever of the following special media that was indicated for its final identification according to Bergey's *Manual* and Holman's *Classification of Streptococci*

Aesculin broth (containing sodium taurocholate) to differentiate micrococcus ovalis from pneumococci.

Litmus milk.

Gelatin.

Potassium nitrate broth (for nitrite production test)

Sugar free semi-solid—1 per cent carbohydrate—serum (for fermentation)

Lactose

Glucose

Salicin

Mannite

Sucrose

Casein digest fluid.

Kendall's K medium

Potato-glycerin juice

Lead acetate semi-solid agar

5 per cent washed sheep cells.

Glucose liver broth

1 pound liver boiled 15 minutes in 1000 cubic centimeters of 1 per cent glucose broth. Filter broth adjust to pH 7.7. 10 cubic centimeters of broth on small cube of the liver in tall tube. Autoclave.

BACTERIA OF THE AIR

A study was made of the bacteria found at various times in the air of the operating room and laboratory. Blood agar plates were exposed for periods of 30 minutes to 1 hour and 30 minutes during the course of a surgical procedure. These plates were placed as near the operative field as possible and left exposed for the duration of the operation. Cultures of laboratory air were obtained by the same method of exposing blood agar plates on the laboratory desk while cultural work was in process.

TABLE I

| Genus | Synonym | Operating room air per cent | Laboratory air per cent |
|------------------------|------------------------------|-----------------------------|-------------------------|
| <i>Corynebacterium</i> | Diphtheroids | 15.4 | 5.8 |
| <i>Staphylococcus</i> | | | |
| <i>Micrococcus</i> | | 61.3 | 59 |
| <i>Aerium</i> | | | |
| <i>Streptococcus</i> | | 6 | |
| <i>Bacillus</i> | | | |
| | Anaerobic spore bearing rods | 58 | 1.9 |
| | Colony-typical group | 58 | |

L. acidulated

From the figures in Table I it is seen that the bacterial flora of operating room and laboratory air is essentially the same. Over 90 per cent of the bacteria recovered in both instances lie in the Micrococci tribe (*Micrococcus*, *Staphylococcus*, *Sarcina*) and *Corynebacterium* genus (diphtheroids).

Of these Micrococci only 5 per cent were hemolytic. This group lies in the parasitic genus *staphylococcus* (8). The others, 95 per cent, fall into the facultative parasitic or saprophytic genera of *Micrococcus* and *Sarcina*. Morphologically and culturally these groups are readily differentiated.

These figures when compared to a similar bacteriological study of portions of the human body differ so markedly that false positive results due to contamination from air borne bacteria can be definitely eliminated.

BACTERIA OF UNPREPARED ABDOMINAL SKIN

These skin cultures were taken from hospital bed patients on whom no skin preparation was attempted. The abdomen was exposed the skin surface rubbed with swabs which had been autoclaved in broth.

TABLE II

| Genus | Synonym | Operating room air per cent | Unprepared abdominal skin, per cent |
|------------------------|------------------------------|-----------------------------|-------------------------------------|
| <i>Corynebacterium</i> | Diphtheroids | 15.4 | 1.6 |
| <i>Staphylococcus</i> | | 61.3 | 37 |
| <i>Micrococcus</i> | | 6 | 3.6 |
| <i>Clostridium</i> | | | |
| | Anaerobic spore bearing rods | | 7 |
| <i>Bacillus</i> | Aerobic spore bearing rods | 58 | 8.6 |
| | Colony-typical group | 58 | |

It will be noted that between the unprepared abdominal skin surface and air there is a marked change in the bacterial flora. Many more streptococci and anaerobic spore bearing rods appear on the skin surface.

The increased numbers of the spore bearing rods and streptococci on abdominal skin is not surprising for in this location bacterial growth is greatly favored by darkness, warmth, and moisture.

BACTERIA OF PREPARED ABDOMINAL SKIN

Our method of skin preparation consists of shaving the skin and cleaning with green soap and water the night before operation. At the time of operation, the abdomen is scrubbed with ether both horizontally and longitudinally until the gauze swab used comes away perfectly clean. The skin is then painted with MBGV 5 (5 per cent methylene blue, 5 per cent gentian violet, in 50 per cent alcohol) until it is deeply stained over an area 2 inches wide on each side of the site of the incision. The surrounding surface is then painted with 2 per cent iodine.

Cultures taken from areas painted with MBGV 5 for periods of 10 to 60 minutes have all been negative. A complete report of this experiment was published in 1929 (6).

Our continued use of this technique from the date of the previous publication to the present time has justified in every respect the confidence which we then held in it.

In discussing the fact that all cultures taken from the skin surface after the application of this technique have been negative, the argument has been advanced that in obtaining the cultures some of the dye must necessarily be picked up on the swab and carried over to the culture media. Thus the media becomes a weak antiseptic solution and is no longer a proper media for the growth of bacteria. As

TABLE III

| Genus | Synonym | Operating room air, per cent | Unprepared abdominal skin, per cent | Prepared abdominal skin | Knife blades, per cent |
|----------------------|------------------------------|------------------------------|-------------------------------------|-------------------------|------------------------|
| Corynebacterium | Diphtheroids | 25.4 | 3.6 | 0 | 30.3 |
| Staphylococcus | | 61.8 | 37.8 | 0 | 17.0 |
| Streptococcus | | 0.6 | 8.0 | 0 | 10.6 |
| Clostridia | Anaerobic spore bearing rods | | 21.7 | 0 | 8.5 |
| Bacillus | Aerobic spore bearing rods | 5 | 8.6 | 0 | 1 |
| | Colon-typhoid group | 3 | | 0 | 0.5 |
| Pseudomonas | | | | 0 | 1.0 |
| Actinomyces | | | | 0 | |
| Micrococcus ovalis | Enterococcus | | | 0 | |
| Mucosus unidentified | | | | 0 | 7.4 |

the small amount of dye which is carried over goes into solution the resultant mixture is extremely weak. Our previous experiments have shown that MBGV 5 cannot be relied upon as an effective antiseptic agent when its strength is less than 1 per cent. Therefore this extremely weak solution is not an effective antiseptic and the argument immediately falls into the discard.

BACTERIA OF THE DEEP SKIN LAYERS

All agree that absolute skin sterilization as deep as the superficial fascia is impossible due to the fact that the hair follicles and sweat glands harbor bacteria and their depths are inaccessible to any known sterilizing agent short of searing or charring. Having come to the conclusion that by using the previously described pre-operative skin preparation technique we are able to obtain a sterile surface field we next made cultures from the knife blades with which we made our skin incision through this sterile field. With a sterile skin surface and a sterile knife blade whatever bacterial growth is obtained must come from the area through which the knife blade has been passed.

A Bard Parker Knife was used. The skin incision was made as deep as the upper layers of the subcutaneous tissues. The knife blade was immediately detached from the handle by using a clean sterile clamp and the blade dropped into culture media. Both aerobic and anaerobic media have been used. Of the knife blade cultures so taken 70.9 per cent have

been positive. For the purpose of comparison Table III shows the flora of operating room air of unprepared abdominal skin of prepared abdominal skin and of knife blades (deep skin layers).

From a study of this table it is readily apparent that a field has been opened in which the bacterial flora is entirely different from any of those previously studied. There is a marked decrease in the staphylococcus genus and new groups appear.

In this situation the flora is widely diversified and is so entirely different from that of operating room air unprepared abdominal skin or prepared abdominal skin that the possibility of contamination from any one of these three is eliminated.

The question immediately arises as to the source of these bacteria. If it were the exterior the general flora must be necessarily similar in character to that found in air or on the skin surface. This is not true. The bacteria may be harbored in the sweat glands and hair follicles or they may be present in all the body tissues or they may represent a combination of these two possibilities. In order to investigate this question the bacterial flora of some deeper structure which can be entered without the possibility of external contamination must be studied. The position of choice for obtaining such cultures is from within the peritoneal cavity. This serous cavity can be approached without opening and may be opened when and with whatever technique is desirable.

BACTERIA OF THE PERITONEAL CAVITY

Cultures were obtained from the fluid of peritoneal cavities by the following technique. The parietal peritoneum was exposed and carefully isolated by sterile towels. A small fold of this membrane was caught between two sterile haemostatic forceps and held away from the underlying structures. Between the points of these haemostats a drop of concentrated phenol was smeared then a small incision was made with a sterile knife dipped in concentrated carbolic acid. The edges of the incision were separated so that a sterile swab could be placed in the peritoneal cavity with out touching any structure until the swab was unbedded deep within the cavity. Since the peritoneal cavity normally contains a small amount of serous fluid, dry swabs were used to collect the material for cultures. Both aerobic and anaerobic cultures were made. By this method we feel certain that all the bacteria obtained were in the peritoneal cavity before it was incised and that no contamination occurred. By the use of a carbolic knife any bacteria which may have been present on the outer surface of the peritoneum were immediately killed so that at the time a swab was passed through this serous layer the cut edges of the incision with which it might conceivably come in contact, were sterile.

In many instances cultures were taken from the serosa of the organ for which the operation was being performed. We have thereby obtained intraperitoneal cultures both from the site of the pathological process and at a distance from it.

The pathological conditions for which operations were performed and from which cultures were taken are classified under five main headings. Cases of appendicitis comprise groups 1, 2 and 3. The classification depends on whether or not the local condition was active and progressive (group 1) active but non progressive (group 2) or dormant (group 3) (7).

Operations performed for other intra abdominal conditions were classified as to inflammatory pathology (group 4) and non inflammatory pathology (group 5).

We classify as of inflammatory origin all cases in which a study of the temperature, white blood cell count and intraperitoneal

gross pathology show that the etiological factor has produced an active combative reaction both general and local. A rise in temperature, increase in total white cell count, increase in the percentage of polymorphonuclears and a shift to the left of the polymorphonuclears local tenderness and rigidity an increased amount of intra peritoneal fluid together with local edema, redness and other signs of inflammatory reaction are the criteria which guided us. Cases in which all of these phenomena are presented in increasing severity we call active and progressive. Cases in which these phenomena are presented as static, we call active non-progressive. Cases in which the phenomena are in recession we call active retrogressive. Cases in which none of the phenomena are presented, we classify as non-inflammatory in origin.

We have adopted this classification because it is comparatively simple from a clinical standpoint and by it we are able to get uniform opinions among ourselves. The cases are not put into these groups until after the operation so that the surgeon is guided not only by the clinical manifestations, but by the gross pathology at the time of the operation. The actual operative procedures herein reported were done by various members of the staff of the Fifth Avenue Hospital. The bacteriological studies were done with no knowledge of the clinical picture of the case.

The classification of appendiceal cases, (groups 1, 2 and 3) are approximately accurate. In groups 4 and 5 however, a discrepancy arises which makes classification difficult. Such conditions as subacute or chronic cholecystitis, chronic salpingitis, etc. may be classified as inflammatory conditions since they are undoubtedly originally produced by bacterial activity. Or they may be classified as non-inflammatory conditions because at the time of operation they are free from all evidences of bacterial inflammatory reaction. We have included all such cases in the miscellaneous intra abdominal inflammatory group (group 4).

In group 5 are included only cases of uterine fibroids, cystic ovaries, retroversions etc., the causation of which is beyond all question and

due to bacterial invasion, and in which no combative inflammatory reaction is present.

By this method of classifying into two groups there can be no doubt cast upon our findings in group 5. It represents the clean peritoneal cavity in which there is no indication of intraperitoneal inflammatory reaction either clinically or on gross examination.

TABLE IV

| Group | No. Cases | No. + Cult. | No. - Cult. | % + Cult. | % - Cult. |
|-------|-----------|-------------|-------------|-----------|-----------|
| 1 | 47 | 43 | 4 | 89 | 11 |
| 2 | 3 | 3 | 0 | 100 | 0 |
| 3 | 33 | 33 | 0 | 100 | 0 |
| 4 | 28 | 30 | 0 | 100 | 0 |
| 5 | 31 | 30 | 1 | 97 | 3 |

Group 1. Active progressive appendicitis—inflammatory.
Group 2. Active non-progressive appendicitis—inflammatory.
Group 3. Dormant appendicitis—non-inflammatory.
Group 4. Miscellaneous inflammatory conditions.
Group 5. Miscellaneous non-inflammatory conditions.

Table IV shows the number and the percentage of positive and negative cultures of peritoneal fluid taken from all classes of cases. Except for group 1, which included many cases of ruptured appendices and advanced active progressive inflammatory processes, in each instance the percentage of positive cultures is practically identical. In group 1, of course, the percentage is higher as would be expected. These results show definitely that the presence of bacteria within the peritoneal cavity is not dependent upon the presence or absence of an active intraperitoneal inflammatory lesion. Almost as many positive cultures are obtained from the clean as from the dirty or contaminated peritoneum.

TABLE V

| Cases | Groups 1, 2, 4 | Groups 3, 5 | All |
|--------------|----------------|-------------|-----|
| + Cultures | 106 | 103 | 209 |
| - Cultures | 78 | 77 | 155 |
| % + Cultures | 28 | 26 | 54 |
| % - Cultures | 73 | 74 | 74 |
| | 20 | 25 | 25 |

Groups 1, 2, 4—Total inflammatory conditions.
Groups 3, 5—Total non-inflammatory conditions.

The figures in Table V point definitely toward a truth which so far has not been generally accepted. It shows the presence of bacteria in what was previously believed to be a sterile area. There are as many positive

cultures in non-inflammatory as there are in inflammatory conditions. It is true that the bacteria found in the two types of cases differ as would be expected, and yet many of the same bacteria are present in both types of pathological conditions.

Whenever the bacteriology of the peritoneum is discussed the question of sex is always raised. Since there is direct communication between the peritoneum and the exterior in the female it is presumed that bacteria can more easily obtain access in this sex. To forestall this contention we have prepared Table VI which divides each group into male and female patients and shows the percentage of positive cultures obtained in each sex. We find that the percentage of positive cultures in males is 79.5 per cent and in females 82 per cent, a difference of 2.5 per cent in 222 cases—an insignificant variation.

TABLE VI

| | Male | Female |
|--------------|------|--------|
| Cases | 86 | 136 |
| + Cultures | 71 | 108 |
| % + Cultures | 82 | 79.5 |
| - Cultures | 15 | 28 |
| % - Cultures | 18 | 20.5 |

In Table VII is shown the relative preponderance of bacteria in the two classes of conditions together with the flora of the knife blades in each group and of the serosa of the inflamed organ in the inflammatory group.

By study of Table VII we find that the numbers of diphtheroids is practically identical whether the intraperitoneal lesion be inflammatory or non-inflammatory. The relative number of diphtheroids found in the peritoneal cavity is practically identical with the number found from cultures of the knife blades.

The knife blade cultures are practically identical for both the inflammatory and non-inflammatory lesions.

In the presence of active inflammatory reactions there are double the number of streptococci than there are where such reaction is not present.

The incidence of colon bacillus in active inflammatory reactions is nearly three times that found in non-inflammatory conditions. This of course is readily explained since in

TABLE VII

| Genus | Synonym | Inflammatory conditions Groups 2, 4 | | | Non-inflammatory conditions, Groups 1 and 3 | |
|--------------------|----------------------------------|--|------------|--------------------------------|--|------------|
| | | Kaife blacks | Peritoneum | Secret of inflamed organ | Kaife blacks | Peritoneum |
| Corynebacterium | Diphtheroids | 41.6 | 3.7 | 34.3 | 41.5 | 37.7 |
| Fusiformis | | | | 7 | 9 | |
| Actinomyces | | | 6 | | 2.5 | |
| Staphylococcus | Hemolytic staphylococcus | | 5.5 | 3 | 3 | |
| Micrococcus | Non-hemolytic staphylococcus | | 3 | | 2.6 | |
| Streptococcus | | 8.3 | 9 | 10.3 | 7.5 | 6 |
| Micrococcus | Enterococcus | 5.5 | 4.9 | 6.8 | | 5 |
| Nanum | Catarrhals | | 6 | | | |
| Undetermined cocci | | 7 | 4 | | | 4 |
| Clostridium | Anaerobic spore bearing rods | 7 | 9 | 5 | 3 | 14 |
| Bacillus | Aerobic spore bearing rods | 8.3 | 4.9 | 6.8 | 5.6 | 9 |
| Pseudomonas | Pseudomonas | | 3 | 3.4 | | |
| Escherichia | Bacillus coli | | 14 | 16.6 | 5.6 | 2 |
| Proteus | | | 6 | | | |
| Salmonella | Paratyphoid | 7 | | 7 | | |
| Escherichia | Typhoid | | 6 | | | |
| Aerobacter | | | 3 | | | |
| Bacteroides | Anaerobic non spore bearing rods | 5.5 | 3 | 3.4 | 9 | 3 |
| Undetermined rods | | | 6 | | | 2 |

These figures are the percentages of all bacteria cultured.

the majority of these cases we are working with inflamed appendices and the *Bacillus coli* a normal inhabitant of this portion of the gastro-intestinal tract, could readily invade and penetrate inflamed intestinal walls even though it might not be the etiological factor.

The groups of aerobic and anaerobic spore bearing rods show greater numbers in non-inflammatory than in inflammatory conditions. At first glance, these findings are the antithesis of what might be expected. By reviewing in detail the cases in which these organisms were isolated a probable explanation becomes apparent.

It is an established fact that the anaerobic spore bearing rods are found at all times with in the lower gastro-intestinal tract. It is also an established fact that within the body these bacteria do not produce spores. It is also known that the rods themselves are easily killed and that it is due to the spores that the genus lives even through most unfavorable

circumstances (3, 9). Since we find 14.2 per cent of these organisms present in non-inflammatory and only 9.2 per cent in inflammatory conditions it seems probable that the presence of active inflammatory reaction since it is a combative phenomenon tends to destroy this type of bacteria. If this is true in active inflammatory conditions we should not find anaerobic spore bearing rods but very occasionally. On examining the patients with active inflammation in which these bacteria were found we see that in practically every instance the inflammation had progressed to the point of necrosis of the organ involved. The presence of necrosis, therefore, appears to be the determining factor as to whether or not these bacteria are found in the presence of active inflammatory reaction. In the cases of appendicitis anaerobic spore bearing rods were recovered 14 times. In 12 of these cases it is definitely stated in the report of the surgeon and the

TABLE VIII GROUP I

| Case No. | Kaife blade | Peritoneal fluid | Serosa of organ |
|----------|---|---|--|
| 33 | <i>Corynebacterium flavidum</i> | <i>Corynebacterium flavidum</i> | <i>Corynebacterium flavidum</i> |
| 34 | <i>Corynebacteria</i> | No growth | <i>Corynebacteria</i> <i>Staphylococcus epidermidis</i> <i>Streptococcus faecalis</i> <i>Escherichia coli</i> |
| 37 | <i>Escherichia coli</i> <i>Micrococcus ovalis</i> Bacilli | <i>Micrococcus ovalis</i> <i>Escherichia coli</i> Bacilli | <i>Escherichia coli</i> <i>Micrococcus ovalis</i> Bacilli |
| 38 | | <i>Corynebacteria</i> | <i>Corynebacteria</i> |
| 40 | <i>Corynebacterium hofermanni</i> | <i>Corynebacterium hofermanni</i> | |
| 42 | No growth | <i>Corynebacteria</i> | <i>Corynebacteria</i> |
| 45 | Unidentified cocci | <i>Escherichia coli</i> <i>Corynebacteria</i> | <i>Escherichia coli</i> <i>Corynebacteria</i> <i>Pseudomonas</i> |
| 46 | <i>Corynebacterium hofermanni</i> | <i>Corynebacterium hofermanni</i> | <i>Corynebacterium hofermanni</i> |
| 48 | <i>Staphylococcus albus</i> | <i>Staphylococcus albus</i> <i>Micrococcus ovalis</i> <i>Escherichia coli</i> | <i>Micrococcus ovalis</i> <i>Escherichia coli</i> |
| 47 | No growth | <i>Corynebacterium hofermanni</i> | <i>Corynebacterium hofermanni</i> |
| 48 | <i>Clostridium</i> | <i>Clostridium</i> | |
| 51 | <i>Bacillus subtilis</i> | <i>Bacillus subtilis</i> <i>Escherichia coli</i> <i>Staphylococcus albus</i> | <i>Bacillus subtilis</i> <i>Escherichia coli</i> <i>Corynebacteria</i> |

Note: Group I—In 6 cases in this group the relationship shown in this table is not found.

TABLE VIII GROUP II

| Case No. | Kaife blade | Peritoneal fluid | Serosa of organ |
|----------|---|--|--|
| 77 | No growth | <i>Corynebacteria</i> | <i>Corynebacteria</i> |
| 78 | | <i>Pseudomonas aeruginosa</i> <i>Corynebacteria</i> | <i>Pseudomonas aeruginosa</i> <i>Corynebacteria</i> |
| 79 | Bacteroides | Bacteroides | Bacteroides |
| 86 | <i>Corynebacterium hofermanni</i> | <i>Corynebacterium hofermanni</i> | <i>Corynebacterium hofermanni</i> |
| 71 | <i>Corynebacteria</i> | <i>Corynebacteria</i> | <i>Escherichia coli</i> |
| 80 | <i>Staphylococcus albus</i> <i>Bacillus subtilis</i> | <i>Staphylococcus albus</i> <i>Corynebacterium pseudodiphtheriae</i> <i>Clostridium tetani</i> | |

Note: Group II—4 cases in this group do not show the relationship shown in this chart.

pathologist that gangrene was present at operation. It seems therefore that these bacteria are frequently present in the body tissues in limited numbers and attenuated forms, that the presence of active inflammatory reaction readily inhibits their growth so that they are not recoverable but that in the presence of necrosis in which instance they can get a foothold in dead tissue they again are found become virulent and invade. This contention is supported by the experiments of Andrews, Rewbridge and Hrdina who found that when finely chopped sterile meat was in-

jected into the peritoneal cavity of a guinea pig the animals were rapidly invaded by anaerobic spore bearing rods and death occurred within a short interval of time (20 hours).

In comparing the flora of the peritoneal fluid and the serosa of the organ in inflammatory conditions, it is to be noted that the figures are almost identical. In practically every instance the figures for serosa of the organ are slightly higher than those for general peritoneal fluids. It is particularly true in the type of bacteria which is normally found in the

TABLE VIII, GROUP III

| Case No. | Knife blade | Peritoneal fluid | Serosa of organ |
|----------|--|---|---|
| 68 | <i>Corynebacterium bovis</i> <i>Clostridium welchii</i> | <i>Corynebacterium bovis</i> <i>Clostridium welchii</i> Bacillus — | <i>Corynebacterium bovis</i> <i>Clostridium welchii</i> Bacillus — |
| | No growth | Bacteroides | Bacteroides |
| 4 | <i>Corynebacterium</i> — | <i>Corynebacterium</i> — <i>Escherichia coli</i> | <i>Corynebacterium</i> — <i>Escherichia coli</i> |
| 7 | <i>Escherichia coli</i> | <i>Micrococcus evans</i> | <i>Micrococcus evans</i> |
| 19 | <i>Streptococcus fecalis</i> | <i>Streptococcus fecalis</i> | <i>Streptococcus fecalis</i> Alcaligenes — |
| 99 | <i>Staphylococcus citreus</i> | <i>Staphylococcus citreus</i> <i>Corynebacteria</i> Colon typhoid group | <i>Corynebacteria</i> Colon typhoid group |
| 100 | <i>Staphylococcus albus</i> Fusiformis | <i>Salmonella</i> — <i>Corynebacteria</i> | Fusiformis <i>Salmonella</i> — <i>Corynebacteria</i> |
| 101 | <i>Clostridium tertium</i> | <i>Clostridium tertium</i> | <i>Clostridium tertium</i> |
| 10 | <i>Staphylococcus albus</i> | <i>Staphylococcus albus</i> Streptococci | <i>Staphylococcus albus</i> Streptococci <i>Escherichia coli</i> |
| 3 | Colon typhoid group <i>Streptococcus equinus</i> | Colon typhoid group | <i>Streptococcus equinus</i> |
| | <i>Streptococcus subacidus</i> | <i>Streptococcus subacidus</i> | <i>Streptococcus subacidus</i> |
| | <i>Clostridium tertium</i> <i>Escherichia coli</i> | <i>Clostridium tertium</i> | <i>Clostridium tertium</i> <i>Escherichia coli</i> <i>Streptococcus equinus</i> |
| 1 | No growth | Streptococci (anaerobic) | Streptococci (anaerobic) |

Group 3—8 cases did not show this type of relationship

lower portion of the gastro-intestinal tract. This is to be expected for whatever bacteria are found at the site of an intraperitoneal inflammatory process must necessarily be spread by means of the fluid content of the peritoneal cavity and the peristaltic action of the intestines.

In 106 unselected cases we have obtained cultures from at least 2 and in many instances all three positions—deep skin layers, peritoneal fluid and serosa of the organ. These cultures are of particular interest when comparisons are made in the same case. Table VIII shows in detail the bacteria found in representative cases from each group. Of the 106 cases in which we have two or more cultures, we find the identical bacteria at more than 1 site in 85 instances. This relationship is therefore shown in 80 per cent of the cases. It is particularly interesting to note that in most instances the bacteria which are found within the peritoneal fluid or on the serosa of the organ are frequently identical to the bacteria which are isolated from the knife blades.

When we remember that the knife blade cultures were taken before even the superficial fascia had been incised and that possible contamination has been eliminated, it becomes apparent that these bacteria must have been in the skin before the operation was undertaken. Many of these cultures show the presence of diphtheroids which is not surprising but it is extremely suggestive to know that in many cases in which the colon bacillus is found at the serosa of the organ it is also disseminated in the peritoneal fluid and is found to be present in the skin as well. Such are the facts.

CONCLUSIONS

1. Our studies lead us to believe that in 80 per cent of instances a growth can be obtained from cultures taken from within the peritoneal cavity.

2. This is true, whether the patient be male or female, and irrespective of the clinical evidence of the presence of intraperitoneal inflammatory reaction.

3. The character of the flora from within the peritoneal cavity differs markedly from that obtained from the air

4. We believe that there is no such thing as intraperitoneal asepsis

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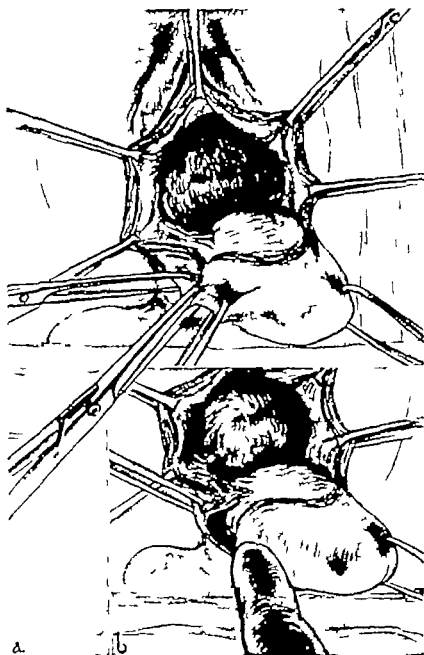


Fig. a, The bladder has been separated from its abnormal cervical and vaginal attachments. The lateral incision of the vaginal wall. b, The approach to the transverse cervical ligament.

An Evaluation of the Blaisdell Operation for Uterine Prolapse.—Byron H. Goff

CLINICAL SURGERY

FROM THE CLINIC OF THE WOMAN'S HOSPITAL

AN EVALUATION OF THE BISSELL OPERATION FOR UTERINE PROLAPSE

A FOLLOW UP STUDY¹

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IN 1918, Douglas Bissell presented before the American Gynecological Society a verbal description of an operation for prolapse of the uterus in women past the menopause and in younger women who have the more marked degrees of prolapse or prolapse associated with uterine pathology. Between the years 1919 and 1932 this procedure has been employed in 116 cases operated upon by the members of the Second Gynecological Division at the Woman's Hospital in the State of New York. Since the patients so treated have been under follow up observation for a period of 13 years it is interesting to evaluate this operation now on a follow up basis. To appreciate fully the conclusions drawn from such a study it is necessary to consider briefly the fundamental anatomical and physiological facts and theories upon which the operation has been based.

NORMAL ANATOMY OF UTERINE SUPPORT

An extensive experience in dissections on the cadaver and in operations on the living subject has convinced Bissell that the uterus is maintained at a normal level in the pelvis by the visceral portion of the fascia endopelvina which extends inward from the sides of the pelvis and is attached to the cervix at the level of the internal os. He feels certain that the most important parts of this fascia are those which are located in the bases of the broad ligaments beneath the ureters and the uterine vessels, and which have been termed the transverse cervical or cardinal ligaments. These ligaments are composed of fibro-elastic connective tissue which as it approaches the cervical attachment interdigitates with smooth muscle fibers from the uterine musculature. The posterior part of the visceral layer of the fascia endopelvina which is

attached to the back of the cervix also aids in the support of the uterus while the anterior portion of the fascia (vesicovaginal areolar fascia) plays no part in uterine support because of its frail structure.

Blair Bell and Goff have published photomicrographs of histological cross sections from the vesicovaginal septa in normal nulliparae which show that the vesicovaginal portion of the fascia endopelvina is composed of an insignificant layer of loosely arranged fibro-elastic connective tissue the supportive properties of which are negligible. Recently Koster who has studied histological cross sections from the vesicovaginal and rectovaginal septa in a normal multipara has found the areolar fascia in both of these septa identical with that in nulliparae.

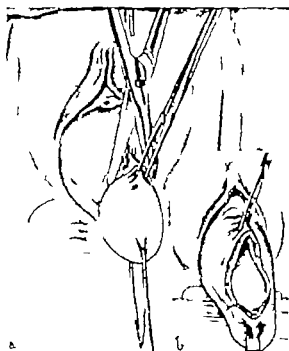
NORMAL PHYSIOLOGY OF UTERINE SUPPORT

With students of intra-abdominal and intra-pelvic pressure Bissell agrees that there is an antagonistic action between the muscles which surround the abdominal cavity and those which close the pelvic outlet, and, that this action may create pressure conditions in the pelvic and abdominal cavities which influence the position of the viscera. Despite the plausibility of this theory he feels that there are clinical facts which cannot be reconciled with it, and therefore regards the function of the pelvic floor (levator ani muscles and fasciae) as a factor of no importance in normal uterine support.

PATHOLOGICAL ANATOMY OF UTERINE PROLAPSE

Since Bissell believes that the transverse cervical ligaments are fundamentally responsible for the maintenance of the uterus at a normal level he reasons logically that the basic etiological fac-

¹Read before the American Gynecological Society May 10, 1931.



a. The opening of the anterior vaginal wall.
b. The entrance to the line of natural cleavage between the vaginal and bladder walls.

in the development of prolapse of the uterus is either a congenital defect in or an injury to these fascial structures. Similar lesions in the part of the fascia endopelvina which is attached to the back of the cervix may also be factors in the development of uterine prolapse, but are of less importance.

In all degrees of uterine prolapse the transverse cervical ligaments are elongated, hypertrophied, and are drawn out in a fan-shaped formation as they reach their cervical attachment.

The part of the fascia endopelvina which forms the floor of the cul-de-sac of Douglas may as a result of injury or congenital defect, become the site of a hernial ring through which a true hernial sac may protrude to pass downward between the posterior wall of the vagina and the wall of the rectum. It is to be borne in mind that such a hernia may occur in association with uterine prolapse or as an independent entity with a uterus in normal position. This part of the fascia when not herniated may become elongated in cases of uterine prolapse with the result that the cul-de-sac is abnormally deepened. This deepening may predispose to hernia of the cul-de-sac.

The uterosacral ligaments which bound the cul-de-sac laterally show no consistent change asso-

ciated with uterine prolapse. In some instances they are markedly hypertrophied while in others they are attenuated into frail strands of smooth muscle.

The part of the fascia endopelvina which is situated between the transverse cervical and the uterosacral ligaments is elongated in proportion to the degree of the prolapse.

In most cases of prolapse of the uterus there is an hypertrophic elongation of the cervix which may or may not be associated with circular hypertrophy of the cervical musculature. In cases of first or second degree prolapse these changes may be more pronounced than in the complete variety. The mechanism which is responsible for these cervical changes has not been satisfactorily explained.

The condition of the body of the uterus in cases of prolapse is variable. Because of the age of the patient in whom prolapse most frequently occurs a senile uterus is the type usually found. It has long been taught that a retroversion of the body of the uterus is invariably associated with uterine prolapse. In a long clinical experience Bissell has observed a considerable number of patients in whom the uterus was prolapsed and at the same time anteverted. Tandler and Halban describe a similar combination of uterine prolapse associated with anteversion of the uterine body.

When considering the pathological anatomy of uterine prolapse it is of the greatest importance to keep in mind the possibility of a kinking of the ureters caused by the downward angulation of the overlying uterine vessels. That such kinking does occur and that it is frequently responsible for hydro-ureter and hydronephrosis with serious damage to the kidney has been demonstrated by Brettauer and Rubin in a study made in 1913. Tandler and Halban have also called attention to this complication of uterine prolapse.

PATHOLOGICAL PHYSIOLOGY OF UTERINE PROLAPSE

The importance of functional impairment of the musculature of the pelvic floor in the etiology of uterine prolapse is a moot subject. Some authors consider it as the principal factor in the causation of this condition while others are of the opinion that it has little or no influence on the position of the uterus. Bissell is of the opinion that it plays no part in the development of uterine prolapse and bases that opinion on two clinical facts. (1) prolapse of the uterus occurs in nullipare who have normal function of the pelvic floor (2) the uterus remains in a normal position permanently in innumerable women who have marked functional impairment of muscles of pelvic floor

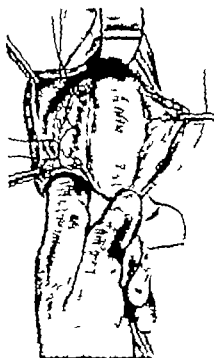


Fig 3

Fig 3. The ligation of the transverse cervical ligament and uterine vessels.

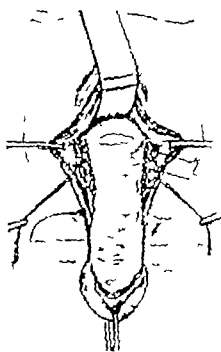


Fig 4

Fig 4. The incision in the uterovesical fold of peritoneum. A The ligated uterine vessels. B The ligated transverse cervical ligaments.

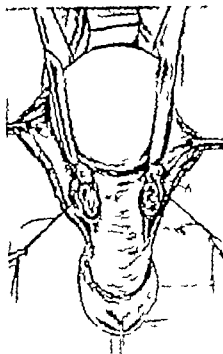


Fig 5

Fig 5. The separation between clamps of the round, broad and utero-ovarian ligaments and the uterine tubes from the uterine body is accomplished. A Indicates the ligated uterine vessels B ligated transverse cervical ligaments

BISSELL OPERATION FOR UTERINE PROLAPSE AND CYSTOCELE

Incision of the anterior vaginal wall (Fig 1 a)
The portion of the vaginal wall which covers the prolapsed uterus and cystocele is bisected by a very superficial lateral incision (in the vaginal

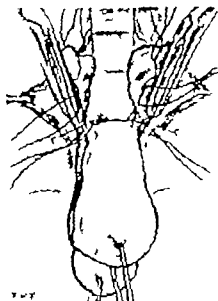


Fig. 6. Ligation of round, broad, and utero-ovarian ligaments and the uterine tubes. A Ligation of uterosacral ligaments, c.

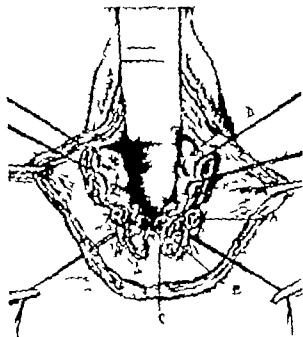


Fig. 7. A The ligated uterine vessels. B The ligated transverse cervical ligaments. C The ligated uterosacral ligaments. D, The ligated round, broad, and utero-ovarian ligaments and uterine tubes.

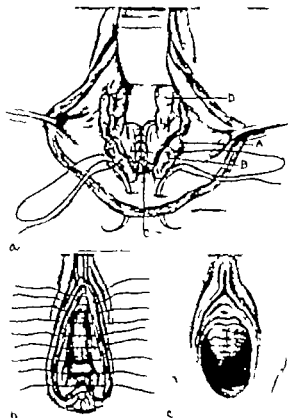


Fig. 8. a. The attachment of the transverse cervical and uterosacral ligaments, *A* and *C*, to the posterior vaginal wall. The obliteration of the cul-de-sac by the union of the uterosacral ligaments, *C*. b. Incision of vaginal wall for correction of cystocele.

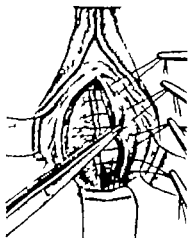


Fig. 9. Bissell lapping operation for cystocele.

mucosa) into an anterior and a posterior half. This incision acts as a landmark which facilitates a symmetrical final closure of the anterior vaginal wall. An equally superficial circular incision is made in the vaginal mucosa at the cervicovaginal junction. In the line of this incision the vaginal wall is opened by a scissors which cut through the vaginal wall (mucosa and muscular coat) to the vesicovaginal areolar fascia. The incision so made forms an artificial pocket (Figure 1 b) which is bounded by the vaginal wall, the cervix, and the bladder. This pocket is lined with an extremely thin layer of areolar connective tissue (the vesicovaginal areolar fascia) some of which clings to the muscular coat of the vaginal wall and the remainder to the muscular coat of the bladder and the musculature of the cervix.

The vesicovaginal areolar fascia marks the line of natural cleavage between the vaginal wall, the cervix, and the wall of the bladder. Because of its frail structure it cannot be dissected as an individual layer and is worthless in the surgical correction of either cystocele or prolapse of the uterus. This portion of the fascia endopelvina is in no way involved in the etiology of cystocele or uterine prolapse.

Separation of the bladder from the cervix and vaginal wall (Fig. 2 a). Following the separation of the bladder wall from the vaginal wall in the midline by a gauze covered finger the anterior vaginal wall is bisected in the sagittal plane from the cervicovaginal junction to the point where the urethra enters the wall of the bladder. The bladder is then separated from its abnormal cervical and vaginal attachments along the line of natural cleavage to the level of the uterovesical fold of peritoneum.

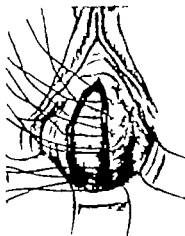


Fig. 10. Bissell lapping operation for cystocele.

The approach to the transverse cervical ligaments (Fig 2 a and b) An incision is made with scissors through the lateral vaginal wall at the level of the cervicovaginal junction. This incision passes through the vaginal wall to the areolar fascia which separates it from the musculature of the cervix. The pocket formed by this incision is enlarged by the introduction of the scissors so that the index finger of the operator may be introduced and pushed upward behind the transverse cervical ligament as far as the uterine vessels.

Ligation of the transverse cervical ligament and uterine vessels (Fig 3) The transverse cervical ligament, which in cases of uterine prolapse is markedly elongated and hypertrophied is ligated by means of interrupted mattress sutures the upper one of which may be made to include the uterine vessels. The uterine vessels are ligated on the uterine side also. The ligament and the vessels are separated from the uterus close to the side of the cervix. The opposite side is treated in a like manner. It will be noted that so far the peritoneal cavity has not been opened. This approach to the transverse cervical ligaments has two advantages over the usual technique of vaginal hysterectomy. (1) It facilitates the recognition and ligation of the transverse cervical ligaments and (2) it prevents early contamination of the peritoneal cavity.

The delivery of the body of the uterus from the peritoneal cavity (Fig 4) The uterovesical fold of peritoneum is cut transversely and the body of the uterus is delivered from the pelvic cavity through the peritoneal incision. At this point a strip of iodoform gauze is placed in the cul-de-sac to absorb any blood that may leak into the pelvic cavity from the site of operation.

Separation of the body of the uterus from its ligaments and the tube (Fig 5) The broad, round, and utero-ovarian ligament and the uterine tube are grasped between the jaws of a Bissell hysterectomy clamp and are separated from the uterus. The protecting gauze is then removed from the cul-de-sac.

Ligation of the uterosacral ligaments (Fig 6) At this point the cul-de-sac is examined for hernia or abnormal depth. The uterosacral ligaments are ligated close to their uterine attachments by sutures which include the fascia endopelvis on either side of and between them. The broad round and utero-ovarian ligaments and the tube are ligated by interrupted interlocking mattress sutures.

Separation of the uterus from the uterosacral ligaments, the fascia endopelvis and the posterior vaginal wall (Fig 7) The uterus is separated from the uterosacral ligaments, the part of the fascia

endopelvis which is attached to the back of the cervix and the posterior vaginal wall. All of the parts of the fascia endopelvis which were originally attached to the sides and back of the cervix plus the uterosacral ligaments are now held by ligatures.

Obliteration of the cul-de-sac (Fig 8 a) If there is a hernia of the cul-de-sac the hernial sac is removed and the cul-de-sac is obliterated by suturing the uterosacral ligaments together in the sagittal plane from their cervical attachments to a point just in front of the rectum. A deep cul-de-sac is also obliterated as a prophylactic measure against the development of a postoperative hernia of the cul-de-sac.

Attachment of the fascia endopelvis to the vagina (Fig 8 a) The transverse cervical ligaments, the portion of the fascia endopelvis which was originally attached to the back of the cervix and the uterosacral ligaments are sutured to the upper end of the posterior vaginal wall at a common point in the sagittal plane just in front of the cul-de-sac. It is obvious that all of the fascia endopelvis which originally gave support to the cervix is now attached to the vaginal vault. It is also apparent that there is no potential hernial point in the vault of the vagina.

The broad and round ligaments are allowed to retract. Before 1913 Bissell experimented with the interposition of the broad and round ligaments between the bladder and the vaginal wall beneath the pubic arch in the treatment of cystocele but abandoned it because it had a tendency to draw the transverse cervical ligaments downward and forward with the result that there was created a potential hernial point in the vault of the vagina.

Operation for cystocele (Fig 8 b) The cystocele which is usually associated with uterine prolapse may be treated by (1) excision of the redundant part of the vaginal wall, or (2) by the Bissell lapping of the anterior vaginal wall.

1 The redundant portion of the anterior vaginal wall is excised as illustrated in Figure 8 b. The excision is triangular in shape with the apex of the triangle at the urethra and the base in the vaginal vault. The cut edges of the vaginal wall are approximated by interrupted sutures. A small rubber tissue drain is placed in the upper angle of the wound. The peritoneal cavity is not closed by suturing the peritoneal cut edges together.

2 The Bissell lapping of the anterior vaginal wall (Fig 9) The mucous membrane is removed from the right half of the vaginal wall by means of an Emmet scissors. The denuded muscular coat is then drawn beneath the left half of the vaginal

TABLE I.—AGES

| |
|----------------|
| 31 to 35 years |
| 36 to 40 years |
| 41 to 45 years |
| 46 to 50 years |
| 51 to 55 years |
| 56 to 60 years |
| 61 to 65 years |
| 66 to 70 years |
| 71 to 75 years |
| 76 to 80 years |

Cases

| |
|----|
| 4 |
| 10 |
| 10 |
| 27 |
| 25 |
| 10 |
| 11 |
| 9 |
| 2 |

TABLE III.—SYMPTOMS

Cases Per cent

| | | |
|------------------------------|----|------|
| Vaginal protrusion. | 86 | 100 |
| Vaginal discharge | 42 | 48.8 |
| Frequency of urination | 32 | 37.2 |
| Dysuria | 17 | 19.7 |
| Urthral incontinence | 2 | 2.3 |
| Dragging sensation in pelvis | 14 | 16.2 |
| Sacral backache | 10 | 11.6 |
| Metrorrhagia | 6 | 6.9 |
| Rectal pain. | 1 | 1.1 |

TABLE II.—PARITY

| |
|------------|
| Nulliparae |
| i-para |
| ii-para |
| iii-para |
| iv-para |
| v-para |
| vi-para |
| vii-para |
| viii-para |
| ix-para |
| x para |

Cases

| |
|----|
| 6 |
| 16 |
| 14 |
| 0 |
| 18 |
| 4 |
| 7 |
| 5 |
| 3 |
| 1 |
| 3 |

wall by interrupted mattress sutures of chromic catgut as illustrated in Figure 9. The cut edge of the left half of the vaginal wall is sutured to the right side of the vagina as illustrated in Figure 10.

The Bussell operation for cystocele was originally termed fascia lapping operation. As a result of histological studies of the tissues which have been regarded as fascia by many authorities on vaginal plastic surgery Bussell (3) has been convinced that the so called fascia is in reality the muscular coat of the vaginal wall, and published his findings in 1929 under the title "Fascia Lapping as Applied to the Tissues of the Vaginal Wall, a Mismomer."

Operations on the pelvic floor. Anatomical and functional defects in the pelvic floor associated with uterine prolapse are corrected by suitable methods in all cases. These procedures are performed, however, for the relief of the symptoms caused by the lesions in the pelvic floor and not essentially as a part of the treatment of uterine prolapse.

The present study includes 116 cases of prolapse of the uterus in which the patients were operated upon by the members of the Second Gynecological Division at the Woman's Hospital. All patients were subjected to the same ante-operative study, the same pre-operative preparation, and the same postoperative care, all of which are standard in the Woman's Hospital. In every case the procedure was performed precisely as described by Bussell. Because of the refusal of 23 patients to return for follow-up examination and

the loss of 7 patients by postoperative death, the end-result analysis has been based on the findings in 86 cases which have been under follow up observation for periods ranging from 1 to 8 years.

PHYSICAL FINDINGS AND CLINICAL PATHOLOGY

A perusal of the pre-operative physical examination and clinical pathological reports in 116 cases under consideration shows them to have been women within normal limits for their respective decades of life with few exceptions. There were 3 cases of marked myocarditis. One patient had in addition to a severe chronic cystitis a large calculus in the bladder. Three patients showed a marked functional hypertension. There were 3 cases of pronounced secondary anemia.

AGE

The ages of the 116 patients operated upon are shown in Table I.

In the 86 cases studied in the follow-up it is an interesting fact that there were 6 nulliparae in each of whom there was a prolapse of the uterus. There were 2 cases with third degree prolapse, 2 cases of second degree prolapse, and 2 cases of first degree prolapse of the uterus. In 1 patient who had a third degree prolapse there was a history of a fall from a scaffolding at the fourteenth year which was immediately followed by a vaginal protrusion. In all of the others the histories and physical examinations failed to reveal any cause other than probable congenital defects in the fascial supports of the uterus. In no case had there been any detectable injury of the musculature of the pelvic floor.

CHARACTER OF DELIVERIES

Of the 80 patients who had borne full term children 60 (75 per cent) had been delivered spontaneously and 20 (25 per cent) had been delivered by operative procedures.

DIAGNOSES

When classifying the degrees of uterine prolapse it is important to consider some definite

TABLE IV—DIAGNOSES

| | Prolapse of uterus 1st degree | Prolapse of uterus 2nd degree | Prolapse of uterus 3rd degree |
|-------------------------------------|-------------------------------|-------------------------------|-------------------------------|
| No cystocele (3) | 1 | 1 | 1 |
| Cystocele | | | |
| Small (4) | 2 | 2 | 0 |
| Medium (45) | 21 | 22 | 2 |
| Large (34) | 5 | 23 | 0 |
| Relaxation of pelvic floor (15) | 0 | 5 | 4 |
| Laceration of pelvic floor (10) | 4 | 6 | 0 |
| Rectocele—small (20) | 8 | 12 | 0 |
| Rectocele—medium (34) | 0 | 23 | 2 |
| Rectocele—large (6) | 1 | 2 | 3 |
| Deep cul-de-sac of Douglas (6) | 1 | 5 | 0 |
| Hernia of cul-de-sac of Douglas (4) | 0 | 2 | 2 |

TABLE V—SUMMARY OF TABLE IV

| | Cases |
|---|-------|
| Prolapse of the uterus | |
| First degree | 20 |
| Second degree | 48 |
| Third degree | 0 |
| Cystocele | 83 |
| Relaxation of the pelvic floor | 15 |
| Laceration of the pelvic floor | 10 |
| Laceration of the pelvic floor with rectocele | 60 |
| Deep cul-de-sac | 6 |
| Hernia of the cul-de-sac | 4 |

uterine landmark in its relationship with various levels in the pelvis. In this series of cases the internal os has been taken as a landmark. When the uterus has descended so that the internal os is at the mid point of the vagina as the patient strains, the prolapse has been termed first degree. When the internal os is at the level of the vulva the prolapse has been termed second degree and when the entire body of the uterus has passed beyond the introitus, the prolapse has been termed third degree (Table IV).

There were 3 cases of uterine prolapse without cystocele. An analysis of Table IV gives the totals shown in Table V.

There were 3 cases in which there was no cystocele. The vaginal wall was excised in 2 cases and lapped in 1 case as a prophylactic measure against the development of cystocele.

There were 16 cases in which no operation was considered necessary because of the slight degree of relaxation or laceration. One case had a perineal operation elsewhere.

ANESTHETIC

The anesthetic employed in 84 cases was either with a nitrous oxide induction. In 1 case spinal anesthesia was given and in 1 case nitrous oxide oxygen gas anesthesia.

POSTOPERATIVE RECOVERY AND COMPLICATIONS

The average postoperative rise in temperature including all of those due to complications was

TABLE VI—OPERATIONS

| | Cases |
|--|-------|
| Operation for prolapse of uterus and vaginal vault | 86 |
| Operation for cystocele (lapping of vaginal wall) | 55 |
| Operation for cystocele (excision of vaginal wall) | 31 |
| Operation on pelvic floor (Emmet operation) | 12 |
| Operation on pelvic floor (Levator myorrhaphy) | 13 |
| Operation on pelvic floor (Goff operation) | 43 |
| Operation on pelvic floor (lapping vaginal wall) | 1 |

TABLE VII—COMPLICATIONS

| | Cases | Per cent |
|------------------------|-------|----------|
| Infections | | |
| Anterior vaginal wall | 2 | |
| Posterior vaginal wall | 2 | |
| Vault of vagina | 1 | |
| Incidence | | 5.8 |
| Surgical shock | 3 | 3.4 |
| Fyrolitis | 5 | 5.4 |
| Rectovaginal fistula | 1 | 1.1 |

101.7 degrees which returned to normal on the sixth postoperative day.

With the exception of 2 complicated cases (51 and 107 days) the average number of post operative days in the hospital was 21.

It was necessary to catheterize the bladder from 1 to 13 days. The indwelling catheter was not used in any case.

MORTALITY

In 116 patients operated upon there were 7 deaths (6 per cent). Bacteremia was the cause in 2 cases, cardiac collapse in 2 cases, surgical shock in 2 cases, and bronchopneumonia in 1 case.

The mortality rate in the series of cases under consideration is high for any vaginal plastic procedure. This has been due to the fact that operative treatment has been employed in 3 cases which were known to be poor operative risks. In each case the risk was explained to the patient and to her relatives and non-operative methods of treatment having failed, operation was elected by the patient as the only means of relief from symptoms which had become unbearable.

When considering a justifiable mortality in patients who have been subjected to vaginal hysterectomy for prolapse of the uterus one should keep in mind the fact that many women who have this condition are not only past middle life but have some general systemic disease. In the light of these facts it is obviously of the greatest importance to subject all such patients to more thorough physical examinations of the cardiovascular and urinary systems and to be guided by the findings in such examinations when making a decision for or against the employment of a major vaginal plastic operation if the mortality rate is to be kept at a justifiable level.

TABLE VIII.—PATHOLOGY

| | Cases |
|----------------------------|-------|
| Cervix | |
| Hypertrophy | 86 |
| Laceration | 38 |
| Erosion | 10 |
| Chronic cervicitis | 25 |
| Polyp | 2 |
| Corpus | |
| Normal | 14 |
| Atrophy (senile) | 52 |
| Myomata | 11 |
| Polyp | 6 |
| Hyperplasia of endometrium | 3 |

PATHOLOGY

A perusal of the reports by the pathologists at the Woman's Hospital in the 86 cases under follow-up study showed the conditions in the uterine body and cervix as outlined in Table VIII.

It is obvious that the uterine body was either atrophied or diseased in 83.7 per cent of the 86 cases. The average length of the cervix was 6.6 centimeters in cases of first degree prolapse, 7.1 centimeters in cases of second degree prolapse, and 7.1 centimeters in cases of third degree prolapse.

END-RESULTS

Inasmuch as follow-up studies which are based on letters from patients or statements of general practitioners are not only worthless but are misleading all such evidence has been eliminated from the study of the series of cases under consideration. In every case herein reported the patient has been subjected to a vaginal examination by one or more of the members of the Second Gynecological Division at the Woman's Hospital. In many instances all members of that staff have recorded their findings in the case. When making such examinations both symptomatic and anatomical conditions have been taken into consideration, and in any instance in which there has been any doubt as to the end-result a consultation with some other member of the division has been sought by the examiner.

The period of follow-up study has varied from 1 to 8 years as follows: 36 cases were followed for at least 1 year, 9 cases for 1½ years, 23 cases for 2 years, 2 cases for 2½ years, 8 cases for 3 years, 2 cases for 3½ years, 2 cases for 4 years, 2 cases for 5 years, 1 case for 6 years, and 1 case for 8 years.

Since prolapse of the uterus, cystocele, relaxation of the pelvic floor, laceration of the pelvic floor with and without rectocele and hernia of the cul-de-sac of Douglas are conditions which occur individually or in combination, the results

TABLE IX.—ANATOMICAL END-RESULTS

| | Success | | Failure | |
|---|---------|----------|---------|----------|
| | Cases | per cent | Cases | Per cent |
| Vaginal hysterectomy for prolapse of uterus and vaginal vault | 86 | 98.9 | 1 | 1.1 |
| Operation for cystocele | | | | |
| Lapping vaginal wall | 55 | 96.0 | 2 | 4.0 |
| Excision vaginal wall | 31 | 93.6 | 2 | 6.4 |
| Operation on pelvic floor | | | | |
| Emmett operation | 12 | 33.3 | 8 | 66.7 |
| Levator myorrhaphy | 13 | 86.7 | 2 | 15.3 |
| Goff operation | 43 | 95.6 | 2 | 4.4 |
| Lapping vaginal wall | 1 | 100 | | |
| Obiteration of deep cul-de-sac | 6 | 83.3 | 1 | 16.7 |
| Obiteration of cul-de-sac (for hernia) | 4 | 50.0 | 2 | 50.0 |

TABLE X.—SYMPTOMATIC END-RESULTS

| | Complete relief | | No relief | |
|------------------------------|-----------------|----------|-----------|----------|
| | Cases | per cent | Cases | Per cent |
| Vaginal protrusion | 86 | 89.6 | 9 | 10.4 |
| Vaginal discharge | 42 | 88.0 | 5 | 12.0 |
| Frequency of urination | 17 | 94.1 | 1 | 5.9 |
| Urethral incontinence | 12 | 75.0 | 3 | 25.0 |
| Dragging sensation in pelvis | 14 | 100.0 | | |
| Sacral backache | 10 | 90.0 | 1 | 10.0 |
| Metrorrhagia | 8 | 100.0 | | |
| Rectal pain | 1 | 100.0 | | |

which have followed the operation for each condition are reported separately in Table IX.

All failures have been apparent within the first 6 months of follow-up observation.

CONCLUSIONS

1. The uterus is maintained at a normal level in the pelvis by the visceral part of the fascia endopelvina, especially by those parts of the fascia which are termed the transverse cervical or cardinal ligaments.

2. The basic cause of uterine prolapse is either a congenital defect in or an injury to the transverse cervical ligaments.

3. Functional impairment of the musculature of the pelvic floor plays no part in the etiology of uterine prolapse.

4. A successful surgical correction of uterine prolapse must be based on a shortening of the elongated transverse cervical ligaments.

5. Symptom producing abnormalities of the pelvic floor associated with uterine prolapse should be corrected by suitable surgical procedures, but such procedures should not be regarded as essential in the treatment of uterine prolapse.

6. The advantages of vaginal hysterectomy in the treatment of uterine prolapse over other methods are (1) it facilitates the shortening of the transverse cervical ligaments, (2) it facilitates the correction of abnormalities of the cul-de-sac of

Douglas (3) it removes a uterus which is either useless or abnormal in over 80 per cent of cases, and (4) it removes the future possibility of neoplastic disease of the uterus.

7 The use of vaginal hysterectomy in the treatment of uterine prolapse should be confined to (1) patients past the menopause whose physical condition warrants a major surgical procedure and (2) younger women who have the more marked degrees of uterine prolapse or prolapse associated with uterine pathology.

8. In addition to the usual physical examination all patients with uterine prolapse should be subjected to a complete pre-operative urological examination for both anatomical and functional abnormalities of the ureters and kidneys which may be secondary to uterine prolapse and cystocele.

9. Spinal and caudal anaesthesia should be used more frequently in cases subjected to vaginal plastic operations.

10 More rigid pre-operative studies, more care in the selection of the anaesthetic to be used and an expedition of the operation should reduce the mortality of vaginal hysterectomy to 2 per cent or less.

11 In the series of 86 cases subjected to follow

up study the prolapse of uterus and vaginal vault has been successfully corrected in 98.9 per cent of cases.

12 Cystocele treated by the Bissell method of lapping the vaginal wall has been successfully corrected in 96.0 per cent of cases.

13 Cystocele treated by excision of the redundant vaginal wall has been successfully corrected in 93.6 per cent of cases.

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DISLOCATIONS OF THE CERVICAL SPINE

THEIR COMPLICATIONS AND TREATMENT

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REPORTED dislocations of cervical vertebrae vary in number from a single instance to Langworthy's notable series of 30 cases of dislocation with no demonstrable fracture seen over a period of 9 years. The writer has had occasion to see and handle 40 cases of dislocation of the cervical spine, with and without fractures, during the last 4 years. Seventeen of these have been previously reported elsewhere (3, 4). The number is not large enough to permit a dogmatic attitude but results have been such as to allow the endeavor to set forth in orderly fashion the obstacles and complications encountered in the entire series.

Table I, giving the origin of the dislocations and the results, is self-explanatory. Table II, giving the complications encountered is the basis of further remarks. The shallow horizontal facets existing between the atlas and the axis account for the predominance of displacement at this point. By the same token, this is the most easily reduced dislocation. It also gives the most anxiety in reduction by reason of the ever haunting fear that the odontoid may be damaged. This should not cause the surgeon to postpone reduction until a possible fractured odontoid has united, as has been suggested by one writer (9). Without reduction, the odontoid will probably unite in malposition. In any case, the union will not be sufficiently firm to remove the risk of reduction.

Fractures of vertebrae constitute the most frequent complication of dislocation. While fracture was demonstrated in only 13 of this series, I believe that it occurs much more frequently than can be demonstrated.

Moore goes so far as to say by general consent, fracture is considered an inevitable accompaniment of a dislocation and it should be considered as present whether or not it can be demonstrated by an X-ray examination. This seems an extreme stand after noting some of the apparently simple dislocations in our experience. On the other hand, X-ray examination showed chip fractures to exist in the apparently simple rotary dislocations of Cases 22 and 27. This is another reason for early reduction. Callus formation may make accurate reduction impossible, even though fracture has not been

visible. In the neck, anatomical accuracy is essential for function, comfort, and union.

Associated fracture of other bones calls for the usual care of the secondary injury. It may be possible to include the lesser fracture in the plaster cuirass for the neck injury. This was successfully done in the fracture of the humerus in one case. It would scarcely seem necessary to warn against overlooking the associated fracture because it is overshadowed by the spine injury.

Injuries to the cord were observed in only 3 cases. Two patients died as the result of injury. The third was Case 35. One attempt at correction failed and further efforts were not permitted by the mother. The child had also cerebral involvement which made it difficult to determine the amount of actual cord damage. This unusually small percentage of cord injuries must be due to the absence of diving accidents in the series. The lay press has noted a large number of diving injuries to the neck with more or less paralysis. The writer has observed several such patients. The immediate cause of death is usually drowning, simply because the paralyzed swimmer cannot bring himself to the surface and is not rescued until too late. Schmieden may have had such cases in mind when he stated that in three-fourths of all cases of dislocation of cervical vertebrae death occurs immediately or soon after the accident as the result of high paralysis of the cord. Otherwise, it is impossible to see how such a high mortality could occur. In this series there were 2 deaths from the injury or 5 per cent.

The damage is done at the moment of impact. With the release of the causative force, the bones of the spinal canal tend to return to their normal relationship, decreasing their impingement upon the spinal cord. The paralyses are caused by the transitory intrusion into the canal of displaced bone or by the pressure of extravasated blood within the dura. This seems to be agreed by all men seeing more than an occasional instance of this injury. It explains the futility of laminectomy as asserted by Taylor after seeing the result of laminectomy with a literal explosion of the cord contents upon incising the thick walls of the dura. Davis and Voth have reported the findings in a cord that has been irreparably damaged by a

dislocation that replaced itself, so that no mal position of the spinal column was found either by X ray or at autopsy. The writer agrees with Taylor that prompt and complete reduction of dislocation by closed manipulation offers the best prospect of recovery from cord injuries.

The absence of cord injury at the time of examination does not warrant minimizing the injury or neglecting the care of the patient. The records of two fatal results were brought to my attention during the past year because of failure to protect dislocations in which cord symptoms had not yet appeared. These patients were brought to different hospitals because of injuries to arms or legs. Both had fallen downstairs. One developed weakness in the right arm. Routine X ray examination revealed forward fracture dislocation of the sixth cervical vertebra with impingement on the spinal canal. She refused to have any reduction or immobilization despite the careful explanation by the resident surgeon. Five minutes later she suddenly went into coma and died. This was 12 days following the injury. There was no new injury she merely moved her head and the cord was destroyed. We must remember that the body of the vertebra had also begun to soften by this time in the course of fracture repair.

The second woman entered the institution a few hours after falling down several steps. She was semi-conscious and hysterical, but deep and superficial reflexes were normal. She complained of pain in head and neck. X ray examination revealed fracture dislocation of the first and second cervical vertebrae. Before correction or immobilization had been applied the patient became comatose and died less than 24 hours after entering the hospital. In an earlier paper (4) it has been stated that these injuries demand more prompt attention than an acute abdominal condition.

Injuries to the cervical roots are of more frequent occurrence; they were seen in 9 of the series. They are usually due to pressure and the patients recover when the dislocation is reduced and pressure relieved. If there is associated fracture the possibility of callus impinging upon the nerve root is always present and is another argument for thorough reduction of the displacement and complete immobilization of the head and neck. A rather common symptom of dislocation of the atlas is pain along the distribution of the greater and lesser occipital nerves persisting after reduction of the long standing cases until the damaged nerve trunk has recovered. Occasionally the damage is permanent in neglected dislocations or in the associated fracture and callus cases.

TABLE I
TYPE OF TRAUMA

| | |
|---------------------------|----|
| Falls | |
| Downstairs | 10 |
| From roof | 2 |
| From ladder | 1 |
| Stumble | 7 |
| Auto accidents | 5 |
| Football accidents | 1 |
| Wrestling accidents | 2 |
| Blows on head | 5 |
| Caught in car door | 1 |
| Standing on head | 1 |
| Chiropractic manipulation | 1 |
| Violent rotation of head | 4 |
| | 40 |

CHARACTER OF VIOLENCE

| | |
|-------------------------|----|
| Self-inflicted accident | 24 |
| Outside trauma | 10 |
| Occupational accident | 7 |
| Home or vicinity | 22 |

LOCATION OF DISLOCATION

| | |
|-----------------|----|
| First cervical | 20 |
| Second cervical | 10 |
| Third cervical | 3 |
| Fourth cervical | 2 |
| Fifth cervical | 4 |
| Sixth cervical | 1 |
| | 40 |

NATURE OF DISLOCATION

| | |
|------------|----|
| Unilateral | 20 |
| Bilateral | 11 |
| | 40 |

RESULTS

| | |
|-----------------------|----|
| Attempted reduction | 37 |
| Complete reduction | 28 |
| Partial reduction | 8 |
| Failure of reduction | 1 |
| Deaths from reduction | 0 |
| Deaths from injury | 2 |

Associated injuries to soft tissues may of course be manifold. The vast majority are of secondary importance. In 2 of our patients Cases 20 and 21 the burns about the face, neck, and chest were so extensive that no effort to reduce the dislocated neck could have been successful even had the condition been recognized at the time. Laymen and surgeons as well considered the deformities to be due to scarring of skin and soft tissues of the neck. Reduction of the displacement of the neck corrected in large part the scar distortion as well. Dr. Brown then restored full usefulness of the impaired arm function by the use of split skin graft (2). It has been suggested that Case 17 might be one of the type described by Berkehauser and Seidler as Non-traumatic Dislocations of the Atlanto-Axial Joint, in which the dislocations were ascribed to respiratory tract

TABLE II—COMPLICATIONS OF DISLOCATION

| | Case |
|-------------------------------------|------|
| Demonstrable fractures of vertebrae | 12 |
| Associated fracture of other bones | 1 |
| Injuries to cord | 2 |
| Injuries to cervical roots | 9 |
| Associated injuries to soft tissues | 3 |
| Congenital anomalies | 2 |
| Redislocation | 4 |
| Lapse of time | |
| More than 1 week | 21 |
| More than 6 weeks | 12 |
| 6 months | 1 |
| 9 months | 2 |
| 11 months | 1 |
| 12 months | 1 |
| 15 months | 1 |
| 21 months | 1 |
| Degree of displacement | |
| Mild | 1 |
| Severe | 24 |
| Extreme | 3 |

infections. The writer believes that such infections render the limiting tissues of the neck more pliable and dislocation more probable following a sneeze, cough, or other minor violence. In this particular instance the patient had undergone tonillectomy anesthesia, and such chances for inadvertent rotation of the sick neck.

Congenital anomalies of the cervical spine added to difficulties of diagnosis and treatment in 2 of our cases. Case 21 had synostosis of the first and second vertebrae. An unusually long spinous process made rotation of the dislocated second cervical impossible until the process had been cut away. This is the only case in the series receiving open operation of any sort. The actual reduction was accomplished by closed manipulation at a later date. Case 33 had elevation of a scapula, Sprengel's deformity. In this instance Dr E. W. Spitznagel, the roentgenologist, stood his ground and insisted that dislocation existed despite inconclusive clinical findings. After manipulation the radiological and clinical pictures confirmed his original opinion.

To determine the incidence of deformities of congenital origin that might be expected in clinical practice, the necks of 200 skeletons were examined, in the collection of Dr Robert J. Terry, professor of anatomy, Washington University School of Medicine. The relatively numerous pathological fusions of two or more vertebrae were eliminated. Six, or 3 per cent, of actual congenital deformities were found. One was an articulation of the odontoid process with the axis. Five were synostoses of different adjacent vertebrae. One specimen was a true case of so called Klippel-Fell's syndrome (10). This particular skeleton would have presented a real problem for diag-

nosis and accurate reduction had he sustained a cervical dislocation in life. The incidence of congenital anomalies is not large enough to constitute a major problem in dislocation but should be kept in mind in the diagnosis and treatment. Nor should the error be made of calling a traumatic dislocation a congenital deformity as was done in at least two of the cases that have come to my knowledge. After such a diagnosis it is difficult to convince the patient that correction can be accomplished and also difficult to protect the good name of the preceding physicians.

Pathological bone conditions may complicate or actually bring about luxation of a vertebra. Destructive spondylitis may cause malformation sufficient to permit the slipping of one or more vertebrae. Such diseases as hypertrophic arthritis and tuberculosis are the most frequent offenders in this respect.

Lapse of time has been a prominent complication of this series, adding much to the difficulties of correction (Table II). The previously mentioned complications cannot be reduced in severity, they simply have to be met as they come. The time element can and should be reduced in such a serious matter as dislocation of the neck. The economic feature is evident. The dangers are obvious, and have been mentioned. I cannot say what should constitute the time limit for attempting reduction. The fact that Case 40 with extreme bilateral dislocation could still be reduced without killing the patient, after 1 year's time would almost lead one to believe that there is no time limit in so called simple dislocation without demonstrable fracture. The only one I have refrained from attempting by reason of lapse of time was a man with typical wry neck and history of dislocation due to a fall from a cherry tree 35 years ago. A ray picture by Dr D. W. Patterson, Port Huron, Michigan, showed rotation of the atlas and axis with compensatory scoliosis of the lower cervicals and various traumatic arthritis changes.

Long continued deformity in a growing child leads to maldevelopment of the bony tissues and after a time there is a structural scoliosis not amenable to correction. Some have stated that dislocations tend to correct their wry necks. In our experience such is not the case. The compensatory scoliosis does not eradicate the deformity. On the contrary the lateral bowing and rotation of the cervical spine become more noticeable with the atrophy of the soft tissues on the downward side of the head and neck. These tissues are not spastic as in toxic or congenital torticollis. They are flaccid being thrown out of use by the

fact that the tilting of the head is due to a definite bony block. The opposing muscles on the sound side of the neck are kept taut by their increased length and effort to bring the head back to its normal position.

Elimination of this distressing complication rests with the clinicians who see the cases in their early days of disability. Demonstration of the unilateral dislocations remains a challenge to the roentgenologist. (11) It is likewise true that the greater responsibility remains with the clinical observer. He must make his own examination and, after careful consultation with the roentgenologist, draw his own conclusions. X-ray examination is imperative but should not be the final word. Sometimes the roentgenological picture is not conclusive but is corroborative of signs brought out by careful physical examination. Many of the long duration cases had been to numerous physicians, surgeons, radiologists and cultists. Diagnoses had varied from rheumatism and infantile paralysis to nervousness. In some cases the correct diagnosis had been made and then the patient was advised that nothing could be done. MacKinnon states that Fractures and dislocations of the spine are common enough to be of interest to the general practitioner. Twelve of his 50 cases were in the cervical region. We have seen other cases for which no adequate treatment was given apparently because the attending physician was at a loss what to do. The condition is frequent enough and its consequences serious enough to demand accurate diagnosis and adequate treatment.

Redislocation is an embarrassing and distressing complication occurring four times in this series. Case 33 was the result of the patient's own misdeemeanor; two were due to insufficient support by the cast, and one, Case 39, followed premature removal of the cast. Each of these recurrences was easily corrected again and put up accurately to prevent further trouble.

An essential feature in the prevention of redislocation, particularly in cases of long standing is to overcorrect, bringing the head and neck into hyperextension, so that the articular processes are firmly seated home in their corresponding facets. Hyperextension must be maintained over a varying but long period of time. Not only does overcorrection insure complete reduction but it stretches the ligaments that have contracted on the anterior aspect of the vertebrae thus preventing their drawing the vertebra out again by sheer force of their contraction.

Treatment must be immediate and thorough. Delay invites tragedy and adds to the difficulties.

Of the various manipulative procedures, Walton's retrolateral flexion with rotation and Taylor's immediate traction with manual manipulation stand out as anatomically and surgically correct. Each has its particular field of usefulness. Not infrequently it has been helpful to supplement one with the other. Reduction with the patient in bed, following with head traction by halter and weights over the head of the bed (16) or head traction and sand bags in lieu of reduction in severe cases (6) is, in my experience, inadequate. A better reduction can be obtained with the patient on a table than on a bed. Full hyperextension of the head and neck over the end of the table is essential as the final step in any technique of reduction. The writer has used any flat table or hospital cart. A strip of steel 4 feet long, 4 inches wide and $\frac{5}{16}$ inch thick is placed on the surface, with the end flush with the head of the table. Later this will furnish support for the shoulders and chest during the application of the plaster cast. The patient is placed recumbent on the table. As soon as he is under the anæsthetic, he is pushed cephalward until head and neck are beyond the head of the table, lying in the operator's hands.

For the Walton technique, one hand is placed alongside of the head on the dislocated side. The other hand is cupped under the chin from the opposite side. That is the operator stands at the head, facing the table. For a left lateral dislocation of a vertebra, the left articular process having slipped anteriorly on its underlying facet, the operator's left hand lies along the left temple and cheek of the patient. His right hand is cupped around the chin with the heel of the hand below the angle of the jaw. The head is carefully but firmly rotated to the right, increasing the displacement, to permit of unlocking the bony block that has taken place. There is usually a slight click as this unlocking occurs but it is by no means constant. The head is held in the position of rotation and flexed laterally to the right, the heel of the hand cupped under the chin being used as an additional help to the anatomical fulcrum of the lateral masses of the vertebrae of the neck. Lateral flexion is carried to the point that the articular process is lifted above the top of the bony block. Still maintaining lateral flexion the head is rotated back to the left, beyond normal range of rotation until the operator is assured that full correction has been secured. Usually a second click is palpable and may be audible as the process clears the obstruction in the facet. The head is then hyperextended and the lateral flexion released. Head and neck must be kept in

extension until the plaster cast has been applied to maintain the position of correction. For a dislocation of the opposite side, the steps of the procedure are the same but the directions are reversed.

I have used the Taylor method in the bilateral type and in the fracture complications. For the Taylor technique the halter or Sayre head sling is adjusted prior to anesthesia. As soon as the anæsthetist can give the anæsthetic from one side, the traction belt is adjusted about the operator's waist or hips and hooked to the head sling. The surgeon will need a heavy pad or cardboard over his lumbar region to prevent this belt from cutting uncomfortably into his lumbar theæca. The writer wears an Osgood belt, or lumbar splint, as a matter of comfort and convenience when using the Taylor traction. Traction is maintained for at least 5 to 10 minutes to tire out muscular resistance. For countertraction on the patient's shoulders, muslin bandages 5 or 6 inches wide are placed prior to anesthesia, one over each shoulder the ends extending diagonally downward across the chest and the back to the opposite thigh. Each shoulder must be protected by the felt pad anticipated for use with the plaster curias. The two ends of each tractor are held by assistants on either side and steady pull maintained to correspond to the traction employed by the operator.

Taylor's original description called for a steady pull in the direction of dislocation, usually anteriorly until muscular tension had been relaxed and the locked processes extended beyond the level of the bony block. The operator then stepped down from the stool upon which he had been standing continuing the traction with the head and neck hyperextended over the head of the table and using the surgeon's fingers to lift the lower cervical vertebrae anteriorly. The assistants must maintain countertraction throughout. Several surgeons have modified the technique using the rotation and side bending of Walton's maneuver during traction. This has real advantages over other reductions described in which the operator uses a steady pull by one means or another and then relies upon anatomical relationships to coax the displacement back into position. The surgeon's hands are free for any indicated manipulation. He must have a definite picture in his mind of the pathological anatomy with which he is dealing and also each step of the reduction. There is usually a very definite sense of "give" or relaxation of the neck spasticity and an audible, or at least palpable, snap as the vertebra slips back into position. After successful

reduction it is possible to rotate the head easily toward the shoulder of the side on which the displacement had existed. If rotation cannot be done fully and easily the correction is not complete and the procedure must be repeated, more force and greater range of manipulation being used.

In cases of long standing, or those with crushing fractures in addition to dislocation, it is necessary to maintain a certain amount of traction until the plaster cast has been completed. With this in mind the writer has had the head sling made of canvas rather than leather. Canvas is less expensive and not as rigid on the patient's head within the cast. Slings may be improvised from muslin or cotton flannel, but leather or canvas made to pattern by a competent maker of orthopedic apparatus are much more satisfactory to the surgeon and comfortable to the patient.

Immobilization is best secured by plaster of paris curias. The most frequently cited objections are not valid, in my opinion. Any immobilization will be distasteful, but the plaster cast, carefully and accurately applied offers the maximum of comfort and safety. Stockinette is first applied to chest, neck, and head, the utmost care being used in handling the patient. Felt pads are applied over pressure points of the shoulders, point of chin and thyroid cartilage. Sheet wadding is smoothly applied in only sufficient quantity to give a smooth lining to the shell that is to follow. More casts are spoiled by excessive sheet cotton padding than by too little. The plaster bandages must be smoothly applied and accurately fitted to the contour of the body care being used not to pull the bandages and crease the shell. As soon as the plaster has set, the openings for face, ears, and armpits are cut out with a round belled plaster knife and the margins of the stockinette fitted over the edges of the plaster. Any surgeon who attempts to care for such a serious condition should be equipped to apply a proper cast.

Vomiting will have to be watched for closely. If the cast is ruined in spite of care, a new one can be applied in a few days with much less trouble now that anæsthetic is not required for the reduction itself. In a few cases of simple dislocation, it has been possible to give the patient a brief gas anesthesia then allow him to sit up for plaster application as soon as awake. This is not feasible in the more severe cases.

The only special apparatus employed by the writer has been the 4 inch strip of steel mentioned above and a length of gas pipe to support the free end of this back support. The steel is

long enough to extend from the first thoracic vertebra to below the buttocks. Patient and underlying steel strip are drawn off the head of the table to permit the application of plaster around the entire upper trunk. A heavy patient causes considerable sag of the head end of the steel, so a length of gas pipe set in a floor flange is placed under the upper end of the steel strip to support the shoulders on a level with the table. After the plaster sets the pipe is removed and the steel strip slid down from within the cast, while assistants hold the patient preparatory to moving him to hospital carriage or bed.

Advantages of plaster curass are numerous. Immobilization is accurate and not dependent upon variable weight pull or the patient's position in bed. The patient cannot wriggle out of his extension or immobilization. He invariably squirms and tries to ease the pull on his head and neck in any traction over the head of the bed. Such pull is not present in the cast and redistraction is guarded against by dorsiflexion of the neck. Nursing care is simplified. The patient can be moved about in bed rolled to either side or lifted, without risk. The surgeon can leave the case with the assurance that his patient is securely held and will not be endangered by any of the possibilities that are ever present in the less positive methods of immobilization. The majority of patients may sit up in bed or in a wheel chair within a few days. Unless contra indicated by the nature of the lesion, they may walk about, wearing the cast, by the expiration of 3 or 4 weeks. In cases of cord injury with trophic skin changes, the cast may be bivalved as described by Conwell to permit of attention to the skin.

After-care varies with the severity of the lesion. All cases except the ones seen early and with slight subluxation, will require plaster curass for 3 weeks as a minimum. In severe dislocations the minimum time for curass is 3 months and an additional 3 months in doll collar. This is also the time required for the neglected displacements of 6 weeks duration or longer. Thomas collar follows for from 3 to 6 months. In lieu of the plaster doll collar one may be made of celluloid where such work can be handled. Otherwise the doll collar may be bivalved to permit physical therapy.

The after-care with physical therapy is important. Baking or diathermy massage and muscle training give much comfort and restore the soft tissues to normal tone and usefulness (8). The muscle training emphasizes the rotation of the head and neck in the direction of correction and in hyperextension particularly. Early in these

exercises, care must be taken not to permit the patient to rotate toward the direction of the former displacement. When the time comes that the supporting doll collar or Thomas collar may be omitted for part of the time such should be done while the patient is fully conscious and aware of his surroundings. While on guard redistraction is not likely to occur. The support must be worn while patient is asleep or when unexpected jolts or strains may occur as in riding in automobiles or street cars.

Psychotherapy comes in for its share in the after-care. These patients are apt to suffer from loss of morale. They must be handled with careful consideration for the personality of the patient as well as thoughtful care for the surgical anatomy of the case. The necessity for long continued restriction of use of the neck muscles must be explained to them. They are told that the first rule of safety for them is chin up to hold the neck in hyperextension. Sufficient successful results are now on record to furnish a basis for guardedly favorable prognosis.

SUMMARY

The cervical region is particularly predisposed to traumatic dislocation of the vertebrae displacement of the atlas predominating. Complications are such as are common to other regions of the spinal column with the addition of lapse of time. Delay in recognition and treatment of cervical displacement is due to the paucity of nerve pressure symptoms and the difficulty in securing conclusive roentgenograms of the multiple processes and facets of the cervical spine. This paper attempts to set forth the necessity and means for accurate reduction, immobilization, and after-care of this increasingly frequent injury. Immediate and positive reduction by closed technique should be used, followed by full immobilization in plaster curass. The fundamental principles of reduction as described by Walton and by Taylor still hold good. Both these writers have been quoted freely and their techniques elaborated in Scudder's notes on dislocations.

The successful reduction of several dislocations of long standing is reported, one being a complete bilateral displacement of the atlas of 12 months duration. The longest duration of a unilateral dislocation prior to the successful reduction was 21 months.

CASE REPORTS

CASE 20. N. E., white girl, aged 11 years, seen at Shriners Hospital with Drs. C. H. Crego, Jr. and J. Albert Key. Eleven months previously this girl had been



Fig. 1

Fig. 1. Case 20. The typical deformity of severe unilateral rotary dislocation of the atlas. Cervical scoliosis, lumbar lordosis, collapse of chest, and malnutrition are due to the dislocation, and not to the burns, a fact which

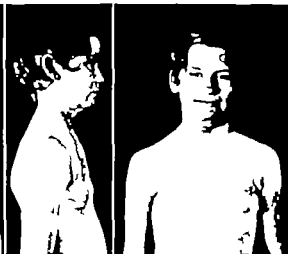


Fig. 2

is clearly brought out in photographs in Figure 2.

Fig. 2. Same patient as in Figure 1, taken several weeks after reduction of dislocation and prior to plastic work on scars.

severely burned when her clothing caught fire. As is usual, the adults knocked the child to the floor to extinguish the flames. When she recovered sufficiently to move about, her head and neck were terribly deformed (Figs. 3, 4). The head was sharply flexed until the chin rested on the chest. The chin was rotated toward the right. There was kyphosis of cervical spine. Slight rotation was possible toward the right, none whatever toward the left. Dr. J. B. Brown pointed out that the chin and head had been pushed down by forces operating in the spine and not pulled down by soft tissue scars and contractures. He insisted that the spinal pathology be corrected before he perform plastic work on the scars. To my pleasant surprise, it proved possible to reduce this extreme dislocation by Walton's technique, on the first attempt, January 26, 1931. X-ray check up 5 weeks later showed tilting of first on second and slight forward displacement of second on third. Without anesthetic, Taylor traction was applied, the head hyperextended, and plaster collar was applied (Fig. 8). Collar was worn 3 months after first manipulation. Celluloid doll collar worn the balance of a year. X-rays showed perfect reduction. The range of motion was normal in all directions (Fig. 2). Dr. J. B. Brown made plastic correction of scarring (Fig. 2).

CASE 3. P. T., 7 year old girl. Interestingly enough, this child was seen with Drs. Crego and Key at the Shriners' Hospital at the same time as the preceding case, with a similar history of being knocked to the floor when her clothing caught fire, 21 months prior to our observation. Efforts at correction had included thorough trial of head pelvic traction over a period of months. Patient had cervical scoliosis, the chin was rotated toward the left shoulder, the right ear was inclined toward the right shoulder. There was no rotation of head toward the right beyond the midline. Right hemi-facial atrophy was evident. Conclusive X-ray pictures were difficult to get, but indicated rotation of both first and second cervical vertebrae on the right. Attempts with both Walton and Taylor techniques seemed to bring about clinical corrections until the cast was applied, but later observation showed no

change. Based on conclusions from X-ray pictures made by Dr. Sherwood Moore that a congenital anomaly existed in the spinous process of the second vertebra, an operation was done on the back of the neck. There was found fusion of lateral masses of first and second on right side, marked enlargement of spinous process of second, which was also fused to spinous process of third, and posterior displacement of left side of second on third. Spinous processes of second and third were cut away to permit movement between these two. After closure, Taylor traction and manipulation was attempted, traction being continued until the cast was applied, but reduction was not complete. In all, 5 attempts at correction were made until on November 19, 1931, 30 months after injury, the posterior displacement of the left side of the axis was corrected and then the anterior rotation of the right side was reduced.

Five months after correction, plaster collar was bi-valved to permit of physical therapy under the direction of Dr. F. H. Ewerhardt. Eight months following the correction, she had good motion in all directions, but it was deemed wise to continue doll collar for fear the vertebrae may have developed in deformity during the girl's 30 months of displacement preceding the final reduction. Another feature developed, malocclusion due to recursive bite. Dr. Leo M. Stanley considers this to be due to cast pressure on the chin and is taking steps to overcome the condition. The scars fastening her right arm to her chest wall were corrected by a one stage split thickness graft operation by Dr. J. B. Brown (3).

CASE 34. J. H., white man of 63 years, referred by Dr. Will L. Freeman of St. Charles, Missouri. On August 21, 1930, he was thrown from a truck, landing in a ditch with neck flexed and another man on top of him. He was treated for contusions and abrasions and an inguinal hernia was operated upon. In hospital, note was made of some pain in the neck, but it was not considered of any great significance. When examined February 9, 1931, he showed the usual signs of incomplete dislocation of the neck, plus pain down the right upper arm. Comparative study of X-ray pictures by Drs. Sherwood Moore and L. G.



Fig. 3, left. Roentgenogram of same patient as in figures 1 and 2, showing extreme displacement of one side of the atlas with the maximum of rotation of the vertebra and the head. (Compare with Fig. 5.)

Fig. 4. Anteroposterior view of the same case as the preceding figures, taken through the mouth. The X ray print has been retouched following accurately the shadows to bring out the actual position of the atlas. The right lateral mass sits in its usual place on the right articular facet of the axis. The left lateral mass lies actually in front of the axis. Compare with Fig. 7.

McCutchen revealed old injury to anterior margin of fifth cervical and anterior displacement of the fifth of moderate amount. February 28, 1931 at Barnes Hospital, under nitrous oxide gas ether anesthesia, Walton maneuver was followed by Taylor traction to assure full posterior replacement. A plaster collar was applied. Examination as late as March, 1932, showed good rotation, but some limitation of other movements. The result must be classed as only partially successful, due in part to delay in recognition of the condition and in large part to inadequate after-care with physical therapy. This was an industrial case in which the Commissioner was unable to believe that a man could have dislocated neck and not suffer more distress while lying in bed in hospital after his herniotomy. The small amount of pain with the patient quiet is striking in many cases (5). A neurological consultant testified at the hearing that a dislocated neck was bound to give neurological findings. This is contrary to the observation of numerous surgeons. Lessons may be learned from our incomplete results.

CASE 26. M. F., white man, aged 26 years, was seen May 4, 1931 at Barnes Hospital, with Dr. Harry Wiese. On the previous day he had dodged a playful blow by his "girl friend" stepped backward suddenly throwing his head backward and sideways. There was a snap and acute pain in the back of neck. He was unable to sleep that night. On examination, both sides of neck seemed full he was unable to fasten his usual collar. The chin was tilted slightly downward and a bit to the right. Both sternomastoids stood out in spasm. Tenderness was present to left of second cervical vertebra. No voluntary rotation was possible in either direction. X-ray by Dr. Sherwood Moore showed abnormality between second and third cervical vertebrae. The second spinous process rotated toward the left. Lateral articular process of second appeared to be elevated and rotated so that its inferior tip over-

lapped the margin of the articular facet of the third. With patient recumbent, neck spasticity and disability continued. During nitrous oxide gas ether anesthesia, the anesthetist caught hold of the patient's jaw elevating it and rotating his head. She noticed that immediately something gave way and his head became freely movable. So by a coincidence, the female of the species brought about the dislocation and then reduced it. This reduction was a happy and humorous one but gives warning that such a disability should not be moved about while under the anesthetist's care for fear of increasing the dislocation or doing damage to a possible fracture. Examination under anesthesia showed complete reduction and range of motion. A Thomas collar was applied, and worn for 6 weeks. Physical therapy was given by Dr. F. H. Ewerhardt.

CASE 29. J. H., colored man, aged 48 years, was seen at the City Hospital No. 5 through the courtesy of Dr. Roland Kleffer, visiting surgeon, and Dr. H. E. Hampton, resident surgeon. He fell from a ladder to the floor a distance of 12 feet, striking on his head. He was unable to straighten his head. Tingling and paresthesia were noted down right arm into fingers. The chin was rotated to the left, the head tilted to the right. X-ray examination by Dr. E. W. Spang showed anterior dislocation of the body of the fourth cervical vertebra, for a distance of $\frac{1}{2}$ to $\frac{3}{4}$ of its depth. The right articular process was also displaced forward. There were chip fractures of the spinous and articular processes. The day following injury reduction was accomplished with the technique of Walton by the assistant in surgery Dr. W. T. Love. X-ray picture corroborated the correction. X-ray examination 4 days later showed redislocation as before. The chin had dropped and rotated during the application of the collar, due to the plaster being wrapped in the direction of deformity rather than in the direction of correction. We should have watched this. Patient was in distress, declar-



Fig. 5



Fig. 6



Fig. 7

Fig. 5. Lateral roentgenogram of Case 40. The body of the atlas lies entirely anterior to the body of the axis. The laminae of the first are resting on the articular surfaces of the second. This being a bilateral dislocation, the rotation noted in Figure 7 does not occur both sides of the vertebrae being equally pushed forward.

Fig. 6. Lateral view of patient shown in preceding illustration, taken through the cast after reduction. The body of the first cervical is seated firmly on the second cervical,

and the tip of the spinous process is shown to be in normal relationship to the spinous processes of the other cervical vertebrae.

Fig. 7. Same patient as in the two preceding illustrations prior to reduction. X-ray exposure through the mouth. The print has been accurately retouched, following the shadows carefully. The atlas lies below the level of the upper surface of the axis, while the odontoid extends well above the upper level of the atlas.

ing that something must be done." The truss was removed, Taylor traction manipulation was applied without anesthetic and a plaster collar applied in position of correction, chin to right and head extended. Immediately after manipulation patient declared that he felt comfortable. After month, plaster doll collar was substituted for the truss. X-ray films showed perfect position.

CASE 32. W. D., colored man, aged 38 years, seen at City Hospital No. 2 through the courtesy of Dr. Heinbecker and Dr. H. E. Hampton. Patient fell downstairs from the second to the first floor on Christmas day of 1931. He entered the hospital the next day complaining of a stiff sore neck. Routine X-ray examination showed no definite evidence of injury. The head was held rigid with chin rotated to right and head tilted to the left. Flexion and extension of head and neck were limited. Rotation of chin to the left stopped at the midline. Second X-ray examination by Dr. E. W. Spitzig showed fracture of odontoid process with anterior dislocation of the first cervical vertebra and skull. There were no gross neurological changes. December 30, 1931, under ether anesthesia no material change in the range of motion was noted. Taylor traction was used for reduction, swinging gently toward patient's right shoulder and then rotating head to the left. Following this, equal motion was found in either direction, within the attempted limits. At the end of 4 months, patient was still wearing a collar, had good range of motion, and X-ray picture showed good position.

CASE 33. W. B., colored boy aged 14 years, entered City Hospital No. 2 on January 23, 1932 because of painful stiff neck. This followed wrestling the preceding day when the second boy fell on the patient's neck. Examination revealed the chin rotated to the left, the head tilted toward the right shoulder, the left sternocleidoid prominent, the left shoulder higher than the right due to

congenital elevation of left scapula. Head motions were fairly free, with slight limitation toward the right. It was thought that this might be due to the congenital deformity but Dr. Edgar Spitzig insisted that the X-ray pictures indicated definite, though mild, anterior luxation of second and third cervical vertebrae, of recent origin. January 25, 1932, under ether anesthesia reduction was brought about by means of Taylor traction, with two definite clicks on extension of the head and neck. A Thomas collar was applied. X-ray examination showed improvement, but still some decrease in normal cervical curve. Walton maneuver without anesthesia, corrected this entirely. Patient went home wearing a Thomas collar. He returned in a week because of recurrence of pain in the neck. X-ray examination showed recurrence of deformity with anterior tilting of the second and third cervical vertebrae. Without anesthetic, the combined Walton and Taylor technique was used. A plaster collar was applied, with chin toward the right. X-ray examination revealed normal position. This was an obstinate patient. He destroyed a large portion of his cast by boring his head against the wall and pulling the cast to pieces. The Psychiatric Clinic dealt with him. He was given plaster doll collar and sent home. April 2, 1932, X-ray examination showed a normal neck.

CASE 34. D. H., 31 year old man, was riding in an automobile that was struck from behind by another car. His head was thrown violently backward then forward. The neck became rigid the next day but the condition gradually subsided under treatment for "sprained neck." He went out on the road again after 3 weeks, but was unable to hold up to his usual work because of pain in head, neck, and back. He was then seen by Dr. Lee D. Cady who found definite parasthesia of fourth and fifth fingers, right, impaired grip in right hand, localized pain along the great

occipital nerve and tenderness over the left sacro-iliac joint. X-ray films by Dr. Sherwood Moore showed compression fracture of fifth cervical vertebra and rotary dislocation of first cervical vertebra on the right side. The clinical examination showed some limitation of rotation of head toward the right and definite limitation of left lateral flexion of head. There was marked tenderness over the right lateral process of the first cervical. He carried his head slightly tilted to the left. The chin was rotated slightly to the left. The right shoulder was lower than the left. Physical therapy was given for 2 weeks at Barnes Hospital by Dr. F. H. Ewerhardt, in an effort to relax the musculature of the neck and back. At Barnes Hospital, May 16, 1932, just 15 months after the original injury, reduction of the neck was attempted, a modification of Taylor-Walton techniques being used. X-ray examination 4 days later showed no appreciable change in the position of the vertebrae. May 26, 1932, under deep ether anesthesia, Walton maneuver gave distinct click at unlocking and louder click at moment of correction and seating home of the articular process. This was audible to the entire audience. There was full range of motion in all directions. A plaster collars was applied.

CASE 39. A. R. 8 year old girl, referred by Dr. O. C. Harner. About 3 months prior to observation patient awakened with pain in head and neck and inability to move her head. The history revealed a fall the preceding day while she was playing in the school yard. She had been seen and treated by some eleven physicians and cultists. Diagnoses had been made of infantile paralysis, rheumatism, fracture of neck. One doctor urged removal of tonsils because of toxic wry neck. A cultist, after 6 "adjustments" stated that her neck was well, all she needed was the will to use it. He urged disciplinary measures to the extent of corporal punishment to compel her to exercise her neck musculature. Dr. J. Eschenbrenner diagnosed the condition as dislocation of the neck, but the X-ray report was "negative for fracture" and the patient passed out of his control. As a matter of fact, the antero-posterior view through the mouth was discarded because it was poor so the displacement of the first cervical was not noted. Examination showed typical rotation of the chin toward the right with marked tilting of the head to the left; no rotation toward the left beyond the midline. Palpation of posterior pharyngeal wall showed rotation of the left side of the first anteriorly. X-ray films made at Lutheran Hospital by Dr. E. W. Spitzig revealed severe rotary dislocation of the first cervical vertebra. The left lateral mass of the first had dropped down in front of the body of the second. June 14, 1932 under ether anesthesia, reduction by Walton maneuver permitted full range of motion to either side. Palpation of posterior pharynx verified reduction confirmed by X-ray examination after application of plaster collars. July 8, 1932 patient had full range of motion. A plaster doll collar was applied and worn for another 5 weeks. She was then given a Thomas collar and allowed to go home, in another town. She returned 10 weeks after reduction with a redislocation, which was again reduced under nitrous oxide gas-oxygen anesthesia by the Walton technique. She was allowed to come out of the anesthesia and was seated on a chair for the application of the plaster collars. Reduction has remained perfect, 4 months since second replacement.

CASE 40. M. F., man of 26 referred by Dr. H. A. LaForce of Carthage, Missouri, with diagnosis of dislocation of neck. The history was that 12 months previously the patient had suffered a lame muscle in his chest after carrying a heavy load. He went to a cultist in a southern state for treatment. The "doctor" had him lie on his back, relax his muscles, and then violently rotated the patient's

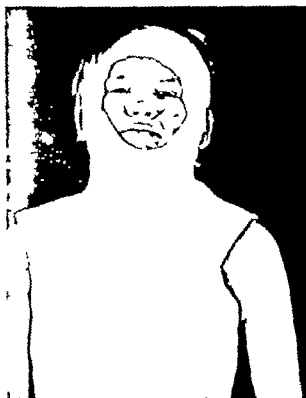


Fig. 8 Plaster collars as applied in Case 39. This picture answers many of the objections to plaster for immobilization after reduction of dislocated necks. The patient is obviously comfortable and ambulatory. Comparison with Figure 1 shows that she has been able to eat well and that full correction has been maintained with head and neck in moderate extension.

head and neck, first to one side and then the other until a definite click was heard in each maneuver. The patient got off the table with a stiff neck that increased in rigidity during the next days and weeks. He has had variable discomfort and limited motion ever since. Examination revealed the head carried anterior to normal position with strained position of chin. Rotation was practically nil to either side. The head was tilted slightly toward the left and the chin was rotated slightly toward the right. The body of the first cervical vertebra was palpable in the posterior pharynx and was markedly displaced forward. Grip of right hand was impaired. Tactile sense in right hand was below par. X-ray films by Dr. F. W. Spitzig at Lutheran Hospital showed complete forward dislocation of the body of the first cervical vertebra, which carried with it the occiput. Both articular processes had slipped forward until the pedicles of the first cervical were resting on the anterior margin of the body of the second, thus allowing the body of the atlas to lie in front of the body of the axis (Figs. 5, 6, 7). June 23, 1932 just 12 months after the original displacement, patient was given nitrous oxide gas ether anesthesia by Dr. E. P. Melners, and reduction was attempted by the Taylor traction method. The body of the first cervical vertebra appeared to be in normal position in the posterior pharynx and rotation of the neck was good. A plaster collars was applied. X-ray examination 5 days later showed the dislocation to exist as originally. This probably was a redislocation during application of the cast. July 1 Walton technique was used first on one side and then the other to maneuver the processes back onto their facets. Taylor traction was then applied to bring the

neck into hyperextension, in which position it was held, under traction while the plaster collar was applied. X-ray through the cast the same day showed complete reposition. Clinical and X-ray examination 16 weeks after reduction show normal position. New doll collar was applied.

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INJURIES OF THE SPINAL CORD AND ITS ROOTS FOLLOWING
DISLOCATION OF THE CERVICAL SPINE

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DISLOCATIONS of the cervical vertebrae always damage the structures of the spine frequently injure the roots of the spinal cord, and sometimes lacerate the cord itself. The dislocation is invariably associated with rupture of the intervertebral disc and of the articular ligaments, and frequently with fracture of the articular processes and crushing of the anterior portions of the vertebral bodies. The direct result of these changes if the dislocation is not reduced, is a certain amount of deformity and limitation of motion. The injuries to the nerve roots are more serious. The roots may be bruised or even compressed between the dislocated bones with resulting pain and paralysis. As dislocations are most common in the lower cervical spine the paralyses of certain muscles of the upper extremities are disabling. Unless the dislocation is reduced, the paralyses may be permanent and even when normal anatomical relations are promptly restored, maximum recovery may not be attained for many months. Laceration of the spinal cord results in permanent interruption of the involved fibers, because being upper neurons, they cannot regenerate. But, in addition to the anatomical lesion, there is a further blocking of impulses due to oedema and hæmorrhage in the tissues of the cord. In an early case of partial or even complete motor and sensory paralysis it is impossible to know how much of the paralysis is permanent because it is due to laceration or how much will clear up when the hæmorrhage and oedema have disappeared. Holmes made clinical and necropsy studies on 50 cases of gunshot wound of the cord, and said: "The prognosis during the first 2 weeks in any one case is extremely difficult, and it must be admitted that there is no one sign or symptom from which we can draw reliable conclusions on the severity of the lesion or from which we can say, when there is complete motor and sensory paralysis, whether the cord is completely divided or not. It must be remembered that though neither the cells nor the fibers of the spinal cord do regenerate very considerable improvement may occur as at least part of the early symptoms are due to oedema, circulatory disturbances, and to incomplete damage. The structural damage is consequently not always parallel to the functional loss."

Surgeons are agreed that operative interference can do nothing for the fibers which are actually lacerated but they disagree about treatment of the physiological interruption. Some believe that immediate laminectomy should be done. They see definite indication for surgery in the experimental work of Allen, and justification in their clinical results. Allen produced supposedly similar injuries to the spinal cords of animals, and claimed that those animals in which the dura was opened within a few hours made better recoveries than those in which the dura was left intact. Coleman modified the indications for early operation to include only those cases of complete or severe partial interruption of motor and sensory impulses in which spinal puncture and compression of the jugular veins (Queckenstedt's test) demonstrated enough swelling of the cord to cause a block in the circulation of the cerebrospinal fluid. He said that these cases should have the pressure relieved to conserve such fibers as escaped destruction by the original injury. If Allen's findings are reliable this is a logical method of selecting cases for operation, and it has been adopted by those who believe in surgical interference.

On the other hand many surgeons, and especially those of large experience in railroad and mine injuries, believe that laminectomy is rarely if ever indicated in these cases. Before the operation was frequently performed they saw instances of partial or complete recovery from paralysis in the course of a few weeks of conservative treatment. They deduced that these changes were due to absorption of oedema and hæmorrhage and pathological studies like those of Holmes confirmed this view. On the basis of clinical experience they refused to accept Allen's conclusions recognizing the many chances for error in such experiments. They could see no difference in the results in comparable cases treated surgically or conservatively provided the operation did no damage and they were convinced that good results following laminectomy would have been the same or better without the operation. Some surgeons gave up laminectomy especially in injuries of the cervical cord because of disastrous experiences. Taylor who has done more than any other to put the treatment of these



Fig. 1. Partial spontaneous reduction of dislocation of cervical vertebra. Case 1.



Fig. 2. Dislocation of fifth cervical vertebra, before reduction. Case 2.

lunes upon a sound basis, states that many years ago he operated in 3 consecutive cases on the first to fourth day after injury, all the patients were in good general condition except for paraplegia when the dura was divided, the cord fractured and all patients died within 24 hours.

The following case reports will serve to illustrate some aspects of the injuries to the spine roots and cord.

CASE 1. A woman 34 years old, was seen December 22, 1924, referred by Dr. S. H. Hurwitz. Immediately after an automobile accident December 20, she had marked weakness of the right arm and leg, which increased for several hours. Examination showed a Brown Sequard paralysis. The right pupil was contracted and did not dilate when shaded. The right deltoid and flexors of the elbow showed about half normal power and the triceps, the flexors and extensors of the wrist and fingers, and the intrinsic muscles of the hand had no voluntary motion. In the right lower extremity all motions at the hip and knee, and plantar flexion of the ankle and toes, were carried out with about one-fourth normal strength, and there was no voluntary dorsiflexion of the ankle and toes. There was no motor loss on the left side. Pain and temperature sensation were absent on the left up to and including the seventh cervical segment, while light touch was detected everywhere. There was no superficial anesthesia on the right side, but sense of position of the toes was diminished. These findings indicated an injury of the right half of the spinal cord at about the sixth cervical segment. There was no deformity of the neck and only moderate tenderness on pressure over the fifth and sixth cervical spinous processes. X-ray films showed a partial anterior dislocation of fifth cervical vertebra (Fig. 1). The patient was kept at bed rest, with light traction on the neck by means of a Sayre head harness, for 3 weeks. A Thomas collar was then applied. At this time

she developed pneumonia and phlebitis of the superficial veins, so that she was not out of bed until the sixth week. The right arm and hand were treated with heat, massage, and passive motion during her stay in hospital. On the sixth day after the injury the triceps and extensors of the wrist and extensors of the ankle showed slight voluntary motion, and the highest level of sensory loss was at second dorsal segment. On the fifteenth day all muscle groups of the right lower extremity had almost one-half normal power, and the upper level of anesthesia was at tenth dorsal. She began to walk in the sixth week. When she was discharged from the hospital, in the fourteenth week, she was walking with a slightly spastic gait, coarse motions could be carried out with the right hand, the right knee jerk and ankle jerk were increased, and plantar stimulation gave a dorsal response on the right; pain and temperature sensation were diminished below tenth dorsal on the left, and the right pupil remained smaller than the left. A year after the accident she reported that she did all of her housework, that she could walk several miles without fatigue, and that she wrote and did fine needlework with her right hand, which was still improving.

In view of the frequency with which the X-ray examination shows a complete dislocation in patients who have no signs of injury to the cord it must be assumed that the dislocation was much more marked and that partial spontaneous reduction occurred. The patient's progress under conservative treatment showed clearly that only a small portion of the motor and sensory loss was due to actual laceration, and therefore permanent. Of the remainder, that due to edema and hemorrhage cleared up in 2 months, but recovery from the root injuries was very slow and had not reached its maximum a year after the accident. It is possible that recovery of the roots would have been more rapid and complete if the partial dislocation had been reduced.



Fig. 3. Dislocation of fifth cervical vertebra, 10 weeks after reduction. Case 2

CASE 2. A man, 30 years old, was seen January 7 1931. He was injured in an automobile accident December 16 1930, and was admitted to hospital December 22. The X-ray films showed an anterior dislocation of fifth cervical vertebra (Fig. 3). From December 23 to January constant traction had been applied to the head without result, as shown by further X-ray examination. He complained of severe pain in the right arm. There had been a complete paralysis of the right arm and leg, and a partial paralysis of the left arm, but by January 7 some improvement had taken place, and the neurological findings were almost exactly as in Case 1. On the right there was a Horner's syndrome, a "lower arm" type of paralysis, and very marked spastic weakness of the lower extremity with increased reflexes and positive Babinski. On the left side there was diminished pain and temperature sensation in the lumbar and sacral distribution. January 9, the dislocation was reduced and the entire spine was immobilized in a plaster dressing. The pain in the right arm stopped at once and did not recur. He was ambulatory from the fourth week after reduction. The plaster was replaced by a Thomas collar in the tenth week. In 5 weeks the strength of the right lower extremity was little below normal, and the grip of the right hand was about one-third of normal. In May, 4 months after reduction, the right lower extremity had normal power though pyramidal tract signs were still present. The grip of the right hand was three fourths normal and still improving. Eight months after injury he reported that he had discarded the collar and returned to manual labor. Figure 3 shows the anatomical condition of the spine ten weeks after reduction, when the plaster dressing was discarded.

In this case the dislocation was not reduced by constant traction but was easily reduced by Taylor's method. The root pains ceased as soon as reduction was accomplished. As in the first case events proved that most of the paralysis was due not to laceration but to hemorrhage and edema of the cord and to injury of nerve roots. If a



Fig. 4. Dislocation of fifth cervical vertebra, before reduction. Case 3.

laminectomy had been done on this patient, it might have resulted in as good a recovery from the cord injury but without reduction of the dislocated bones, there would certainly have been a less satisfactory return of function in the involved upper extremity and the permanent loss due to root injury would probably have been disabling.

DIAGNOSIS

The injury to the spine may be suspected from the history of the accident the position of the head, the patient's disinclination to move the neck because of pain and the tenderness on palpation but lateral X-ray films give all necessary information without risk to the patient. The neurological examination pictures accurately the extent of interruption of motor and sensory impulses but a total functional interruption does not necessarily mean a transection of the cord and a complete anatomical interruption cannot be diagnosed for several weeks.

TREATMENT

These cases have been treated with a few modifications, by the method described by Taylor. To prevent further injury the patient should be handled with great care while being moved; he should be put on a flat hard bed without flexing the neck and the head should be temporarily immobilized with sand bags or with light traction. Lateral X-ray films are made without moving the patient, who remains upon his back on the bed or stretcher. The reduction is then done. Taylor said, a proper fracture table (e.g. Hawley's) must be available a good orthopedic associate must be present and a good portable X-ray



Fig. 5. The plaster dressing. Dotted line indicates level of wrist joint. Note the dorsal flexion of neck, upward pressure of plaster on mandible and occiput, and downward pressure on shoulders. Case 3.

machine and technician must be ready to take and develop plates to verify the reduction.

The patient is placed upon a Hawley table. A Savre harness is applied to the patient's head with attached ropes tied around the operator's waist so that he can control the patient's head and neck with his hands while applying traction with his body. General anesthesia is unnecessary and inadvisable. The operator pulls gently against countertraction, in the line of the cervical spine proximal to the dislocation until the muscles of the neck are relaxed; he then changes the line of pull so that the head drops backward, meantime manipulating the region of the dislocation with both hands. There is usually a snap when the bones go into place which may be felt by both the patient and the operator. With the neck in as complete extension as is comfortable for the patient, an X-ray film is taken and developed. If the reduction is satisfactory, the associate applies a plaster dressing to the head and to the entire spine, while the operator maintains the position with gentle traction. The plaster should press



Fig. 6. Dislocation of fifth cervical vertebra, 1 month after reduction. Case 3.

upward against the occiput and mandible, and downward against the shoulders. The patient may be ambulatory as soon as the plaster is dry or when recovery from paralysis allows. Taylor replaces the plaster dressing after 3 or 4 weeks with a spinal brace with jury-mast and cupped arrangement to hold up the chin and occiput, but I have kept the plaster on for 2 or 3 months and then applied a Thomas collar to be worn for 6 or 8 months. For several weeks after reduction, occasional lateral X-ray films should be taken to be sure that there has been no recurrence of the dislocation.

These patients should not be transported farther than to the nearest hospital even though Taylor's three essentials—a Hawley table, an orthopedic associate, and a portable X-ray machine—may not there be available. The X-ray problem may be solved by doing the reduction in the X-ray room; in fact, if the local doctor's office is equipped with an X-ray machine, it is better in small communities, to reduce these dislocations in the doctor's office especially if the nearest hospital is at a considerable distance. As to the application of the plaster cast, the general surgeon, who is usually in charge of these cases is sufficiently skillful with plaster but he is greatly handicapped if a Hawley table is not available, for without it, the application of a plaster from the pelvis to the head, without disturbing the reduction, is most difficult. As a Hawley table has rarely been available in my experience I have worked out a modified method of applying the plaster as described in the following case.

CASE 3. A man, aged 30 years, was seen September 29, 1932. September 25, he fell a distance of 20 feet striking his head. He had severe pain in the neck, made worse by motion, and numbness and weakness of the left arm. Examination showed slight diminution of sensation in fifth and sixth cervical distribution on the left, and about 50 per cent reduction of the grip of the left hand. The roentgenograms (Fig. 4) showed a dislocation of fifth cervical vertebra. September 30 the reduction of the dislocation was proved to be perfect by X-ray examination before the application of the plaster which was accomplished with considerable difficulty by pulling the patient up so that the buttocks rested on the table and depending upon an orderly crouched under the patient's body to support the shoulders. Films taken a week later showed that the dislocation had recurred. October 11 the plaster was removed, and the patient was placed face downward with his upper chest and pelvis upon two padded boxes. A plaster dressing was applied from the axilla downward to include the crests of the ilium. After this had dried, he was turned on his back and the shoulders were brought over the end of the table. I had controlled the position of the head during these procedures, and I now did the reduction. My associate then applied the remainder of the plaster making a wipe joint with the body cast. After a week the patient was ambulatory. Figure 5 shows the plaster dressing, which was worn for 3 months without discomfort. Occasional X-ray films confirmed maintenance of the reduction. A Thomas collar was worn for 5 months more. Roentgenograms taken 11 months after the second reduction show that anatomical relations remained normal (Fig. 6). As to the root injury the pains ceased immediately on reduction, and the arm regained normal motor and sensory function in about 6 weeks.

RESULTS

Reduction was attempted in all but 3 of 12 cases. These 3 were Case 1 in which the position was, perhaps mistakenly considered satisfactory, and 2 cases without cord injury and with slight and recovering root injuries, seen more than 3 months after injury with X-ray pictures showing new bone between the dislocated bodies. Of the 9 attempted reductions 6 were complete with 5 anatomical results similar to those pictured in Cases 2 and 3. In the sixth case one of complete anterior dislocation of third cervical vertebra without injury of the cord, normal anatomical relations were restored twice on the day after injury and again 6 weeks later but each time the dislocation recurred partially after application of the plaster dressing. The procedure used in Case 3 had not been worked out at that time. The functional result was surprisingly satisfactory as the root pains disappeared and motions of the neck were painless and only moderately restricted. In this case the result would not have been so good if the dislocation had been lower involving the roots to the arms. The two partial reductions were in old cases, 6 and 15 weeks after injury, in each the position of the bones was markedly improved and both patients regained normal posture and motions of the neck.

and one eventually recovered from root injury. One complete failure to reduce occurred in a case of transection of the cord by dislocation of the fourth cervical in which gentle traction caused marked disturbance of pulse and respiration the patient died a few hours later.

Three of the 12 patients died. Of these 2 survived less than 2 days after injury and autopsy showed complete transection of the cord. The third death was not satisfactorily explained. The patient had injury of the roots but not of the cord. The dislocation was reduced 8 days after the accident. Progress was perfectly satisfactory up to the fourth night after reduction when death suddenly occurred. The coroner's physician reported that the cervical vertebrae were in normal position and that the cervical cord showed no evidence of trauma. He believed that the patient died of heart disease. The results as regards injury of the cord were 2 deaths, 2 partial recoveries (Cases 1 and 2) and 1 complete recovery. Of the 10 patients who showed signs of injury of the roots 3 died, 5 made complete recoveries and 2 made partial recoveries from the root injuries.

CONCLUSIONS

1. Laminectomy can do no good in cases of injury of the cervical cord resulting from dislocation of the spine and may do harm.
2. Reduction and fixation of the dislocation by Taylor's method offers the best chance for restoration of function in the spine, the nerve roots, and the spinal cord, in so far as the injury to the cord is not due to actual laceration, which is incurable.
3. Transportation of these patients before reduction and fixation is extremely dangerous. I have described modifications of Taylor's method which obviate the necessity of a Hawley table, a portable X-ray machine and an orthopedic associate so that proper treatment can be carried out in the nearest hospital or doctor's office in which there is a stationary X-ray machine.

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FRACTURE OF THE FEMORAL NECK

BILATERAL HIP SPICA IMMOBILIZATION¹

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THE Whitman method for the management of fresh fractures of the femoral neck which is based on sound anatomical and physiological principles has been accepted by the medical profession. Normal alignment and accurate apposition of the fractured surfaces can usually be obtained by the Whitman manipulation (traction internal rotation and abduction). This procedure is favored in general for the treatment of fractures of the neck of the femur with displacement of fragments. Artificial impaction to produce interpenetration of broken surfaces is advocated by Cotton as a supplement to the Whitman manipulation. The abduction method has three great advantages over any other method—comprehensive mechanical effectiveness, single control and general availability (Whitman).

The following statements will review for the reader many facts and problems encountered in the care of fractures of the neck of the femur.

1. Fracture of the neck of the femur occurs most frequently in elderly people.

The fracture is ordinarily associated with a relatively slight injury.

2. If there is displacement of the fragments the position of deformity of the affected extremity is flexion, adduction, and external rotation.

3. The patient may have none of the classical signs of fracture and little or no immediate functional disability.

4. Impacted fracture of the neck of the femur is uncommon.

5. The danger of life is great, especially in the very aged patients who at the time of the injury are suffering from a cardiovascular renal disease.

6. The mortality rate and incidence of non-union increase rapidly after the age of 60 years.

7. The causes of death are usually (1) shock resulting from the trauma and pain and (2) hypostatic pneumonia.

8. The pain can be entirely alleviated by immobilization of the affected extremity in a plaster-of-paris hip spica.

9. The conservative manual manipulative Whitman-Cotton method of reduction is favored in general.

10. The plaster hip spica which is applied should permit the sitting position which aids in the prevention of hypostatic pneumonia.

11. The incidence of decubitus over the sacral region and lower back depends largely upon the type of plaster spica used and the nursing care during the period of plaster immobilization.

12. Plaster-of-paris hip spica is essential for absolute immobilization of the fractured fragments.

13. Normal alignment and accurate contact of fractured surfaces are prerequisites.

14. Failure of perfect anatomical reduction of the fragments and inadequate immobilization are very likely the two most important factors among the causes of non-union.

15. Continuous, absolute, uninterrupted immobilization with the fractured fragments in normal alignment and firm contact favors the development of bony union.

16. Non-union aseptic necrosis of the femoral head absorption of the femoral neck, traumatic arthritis and soft tissue contractures are not uncommon local complications.

17. Traumatic arthritis of the knee is a frequent complication, if during the manipulative reduction internal rotation is obtained by applying undue force distal to the knee. The position of internal rotation should be accomplished mainly by upward force applied through the operator's fist against the extensor aspect of the greater trochanter.

18. Chronic arthritis may prevent a fractured hip from ever becoming useful.

19. Non-union does not necessarily result in great functional disability.

20. Open reduction with metal or living bone internal fixation should be attempted only by those surgeons who are thoroughly familiar with hip joint anatomy and skilled in the surgical technique used in open reduction of fractures.

The purpose of this report is to present a type of plaster-of-paris hip spica which the writer has used for several years. Also the author wishes to emphasize certain obvious but frequently neglected principles of physical therapy which should be applied during the period of immobilization. The bilateral hip spica (see photograph) offers the following advantages.

1. The plaster cast does not break at the level of the affected hip. The cast may be serviceable for several months.



Fig. 1. Bilateral plaster-of-paris hip spica with four plaster cross bars. Cast does not extend above the crests of the pelvis. Foot segment is in equinus to permit active mobilization of ankle joint through the full ranges of motions. The cast permits the sitting position, minimizes the problem of decubitus, simplifies the nursing care, and remains intact.

2 The nursing care is simplified. The patient may be turned without discomfort by one assistant, and, if necessary may be transported with ease.

3 Patient may assume sitting position which aids in prevention of hypostatic pneumonia. The cast does not extend above the crests of the pelvis. A cast which encloses the abdomen and lower thoracic region precludes the sitting position.

4. The sacral region and lower back can receive the proper nursing care and the dangers of decubitus are lessened.

5 There is absolute immobilization of the pelvis and affected hip.

6 The integrity of the neuromuscular and articular mechanisms of the ankle and foot of the affected extremity and the knee, foot, and ankle of the unaffected extremity is easily maintained.

Inactivity and disuse of the soft tissues should not be permitted during the several months of immobilization. The surgeon should instruct the patient to contract actively all muscle groups of the lower extremities and the abdominal muscles. The muscle groups of the upper extremities may be kept active by occupational therapy.



Fig. 2. Bilateral hip spica bivalved, showing the relation of the plaster cross bars to the anterior and posterior halves.

Muscle groups may be actively contracted with or without joint motions. The muscle groups controlling the immobilized hips and knee should be actively contracted frequently each day without joint movements. The muscle groups controlling the ankles, feet, and knee which are not immobilized by the cast should be actively contracted with full ranges of joint motions. Time and patience are essential on the part of the surgeon while instructing the patient and attending nurse until he is certain that the patient can voluntarily actively contract and mobilize the muscle groups and articulations mentioned. Active muscle contractions with or without joint movements is a form of physical therapy which will help to maintain muscle tone and the integrity of the neuromuscular circulatory and articular mechanisms. It aids in the prevention of contractures and loss of muscle tone and power factors which have a definite relation to the final functional result.

FRACTURES IN THE LOWER ONE THIRD OF BOTH BONES OF THE FOREARM IN CHILDREN

MANIPULATIVE REDUCTION¹

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FRACTURES in the lower one-third of both bones of the forearm in children constitute a clinical entity as definite as Colles' or Pott's fracture. This fracture is a rather common one in children between 5 and 13 years of age.

In an analysis of 123 fractures treated recently by the writer it was found that 22 (17.9 per cent) were fractures of both bones of the forearm 18 (14.6 per cent) of the total being in children, the 4 remaining cases (3.3 per cent) of the total being in adults. Colles' fractures were not included. Of the 22 fractures of the forearm 14 (63.6 per cent) were in the lower one third in children. The 4 others (18.1 per cent) of the fractures of both bones of the forearm in children were in the middle one third. Bagley in a series of 200 cases found that when both bones were fractured 90 per cent were in the lower two-thirds. Magnuson also noted that the most frequent site of fracture of the forearm was in the lower third. Grossman reported 500 cases of fractures of the forearm in children ranging from 6 weeks to 13 years of age. Heen analyzing 38,627 fractures, reported 5.1 per cent in both bones of the forearm. Of 44 cases of fractures of both bones of the forearm Eliason states that 374 were in the lower one third.

A study of the literature and standard text books on fractures, with few exceptions, discloses no exact technique for reduction of fractures of both bones of the forearm in the lower one-third. Usually such fractures are discussed under general treatment of fractures of both bones of the forearm without reference to any special procedure. The treatment of this type of fracture is as different from that of fractures higher up in both bones of the forearm as is the treatment of fracture of the neck of the femur from that of a fracture in the lower one third of that bone.

The purpose of this paper is to present a definite manipulative technique used in this series of fractures in the lower one third of both bones of the forearm. By this method the writer was able to reduce both bones, obtaining normal contour and function in all of the cases.

The mechanism concerned in the etiology of this fracture is usually the same as that which in

an adult produces a Colles' fracture namely a fall on the outstretched hand. Whether such a fall will cause a displacement of the distal epiphysis of the radius or will produce a fracture of one or both bones depends upon the force of the injury and the inclination of the wrist.

Skilern reported 100 cases of fracture of the radius and ulna and found that 13 per cent of them were in the lower one-third and that the mechanism was gravity with momentum.

A brief review of the anatomy helps to explain the mechanism of the forces involved in the etiology, as well as the forces and principles involved in the treatment to be described.

The epiphyses of the radius and ulna unite about the twentieth year. The distal radio-ulnar joint has a trochoid-rotary motion. The distal radio-ulnar and the radiocarpal joints are firmly bound together by a capsule (Fig. 1) which is subdivided into four portions. The lateral radiocarpal ligament extends from the tip of the styloid process of the radius to the base of the tuberosity of the navicular bone. The medial ulnocarpal ligament extends from the styloid process of the ulna to the triquetrum with some fibers extending to the pisiform bone. The volar radiocarpal ligament extends from the volar margin of the distal end of the radius and the base of the styloid process of the ulna, obliquely distally and medially to the volar non-articular surfaces of the proximal row of carpals. The fibers from the ulna run obliquely laterally. The deep fibers are closely adherent to the volar border of the articular disc of the distal radio-ulnar articulation. The dorsal radiocarpal ligament extends from the dorsal margin of the distal end of the radius in an oblique direction distally and medially to the dorsal non-articular areas on the proximal row of the carpal bones.

The Interosseus membrane of the forearm is a strong fibrous band which stretches across the interval between the radius and ulna. This membrane and the distal radio-ulnar ligament (Fig. 2) assist in the reduction of the fractures to be described.

The pronator quadratus muscle (Fig. 3) on the volar surface of the forearm near the wrist takes

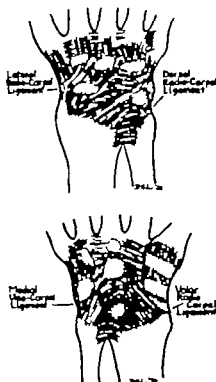


Fig. 1 The ligaments about the wrist.

its origin in the lower one fourth of the volar surface of the ulna proximal to its neck. The fibers pass laterally and distally to be inserted into the volar surface of the lower one fourth of the radius. Anterior to the pronator quadratus lie the radial and ulnar arteries and nerves, the deep veins, and the flexor tendons. In a fracture of the lower one third of both bones of the forearm, supination stretches the pronator quadratus, pulling the distal radial fragment ulnarward and increasing the overriding as well as the displacement. Supination also stretches the pronator radii teres, pulling the proximal radial fragment anteriorly that is volarward or into pronation.

On examination one finds a silver fork deformity with radial deviation of the hand (Fig. 4). In

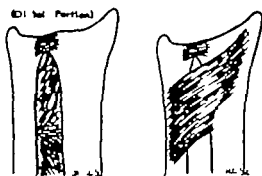
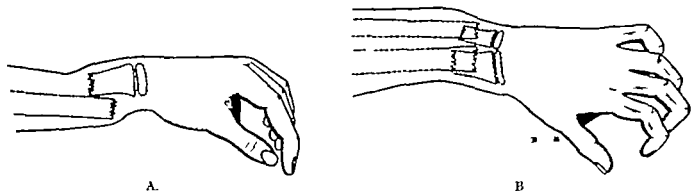


Fig. 2 left. The distal portion of the interosseous membrane of the forearm. Note the direction of the fibers.

Fig. 3 The pronator quadratus muscle. Note the obliquity of the fibers and their attachments. In fractures of the lower one third of both bones of the forearm, supination stretches the muscle pulling the distal end of the radial fragment ulnarward.

addition to this deformity which resembles that of a Colles fracture there is also ulnar angulation. Unless the fragments are impacted there is preternatural mobility and crepitus. Usually both distal fragments are posteriorly displaced and overriding. In fractures in the lower end of the radius the hand can be greatly hyperextended (Maisonneuve's symptom). Frequently in the very young the fractures in both bones are greenstick. Often only the ulnar fracture is greenstick while the radial fracture is complete and overriding (Fig. 5). Outlining the styloids of the ulna and radius, one finds that they are approximately level as compared with normal in which the radial styloid is about one-third of an inch distal to the tip of the ulnar styloid. There is swelling of the wrist, hand, and fingers. Occasionally the radius is compounded. More rarely both bones perforate the skin. The roentgenograms show the position of the fragments which are usually dentated and frequently comminuted. When they are impacted the angulation is anterior the distal radial articulation facing posteriorly and distally (Fig. 6).



A.

B.

Fig. 4. A. The silver fork deformity. The dotted lines indicate the displacement of the radius. B. The radial deviation of the hand. The dotted lines indicate the displacement of the fractured bones.



Fig 5 Case 6 Completely displaced fracture of radius and greenstick fracture of the ulna with angulation. Before and after reduction



Fig 6 Case 7 Typical fracture of both bones of the forearm with complete displacement of both bones. Note the anterior angulation of fragments, the distal radial articulation facing posteriorly the apparent good position in the antero-posterior view showing need for two views in all cases.

In discussing the treatment of these fractures, Ellason speaks of pronation and reduction but does not describe any specific maneuver. Scudler states that fractures of the radius and ulna should be reduced by strong even traction the bones being pressed into position at the same time, and that the forearm should be strongly supinated and Hellinch, admitting that these fractures deserve special mention, recommends that they be reduced and fixed midway between pronation and supination. Wilson and Cochrane emphasize that the convexity of the radial shaft permits it to swing across the ulna in pronation without impinging and that flattening of this curve causes mechanical interference. This crossing occurs obliquely in the upper one third. While it is an important consideration in fractures in the middle and upper one third, the question

of synostosis due to crossing of the bones is not pertinent in fractures of the lower one third. Synostosis in simple fractures in the lower one-third must invariably be due to improper reduction. Keen states that adhesion of the two bones to each other is rare. The writer feels that *complete pronation maintains the necessary radial curve and helps to fix the upper fragments*. This facilitates the reduction of these fractures. DaCosta states that "In fractures of the radius and ulna near the wrist the upper fragment of the radius is pronated." It has always been a general rule in the treatment of fractures to align the lower fragment with the proximal one. Any attempt at supination after the fragments have been reduced tends to displace the distal fragments dorsally angulating them anteriorly. Wilson and Cochrane state that "fracture of both

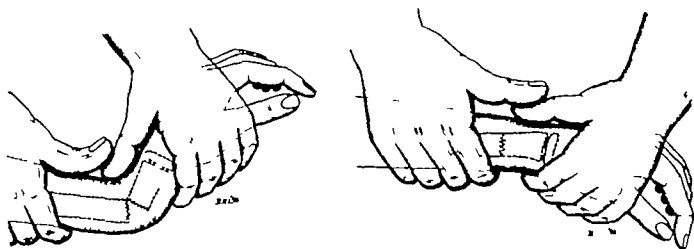


Fig. 7. A, left, The maneuver emphasizing angulation and distal push of the superimposed thumbs of the operator. B, The alignment of the fragments.

bones is one of the most difficult of all fractures to treat, and open reduction is more frequently resorted to than in the case of many other fractures, but closed methods should be given a fair trial.¹⁷

Santy urges early, almost emergency operation when there is displacement with fracture of both bones, and states that every hour wasted on non-surgical measures makes surgical intervention more difficult. Todd reduced these fractures by inserting a metal pry pin. Ghormley and Mroz state that often the only method of

getting satisfactory reduction of these fractures is by open reduction. Grossman does not describe the type of manipulation which he employs but states that the cast extends from the elbow to the metacarpophalangeal joints. In fractures of both bones of the forearm higher up he includes the arm and elbow.

Conwell employs a procedure similar to that to be described, but he applies board splints which do not include the arm, and the hand is held mid



Fig. 8. The cast from midarm to metacarpophalangeal crease, with the forearm completely pronated.



Fig. 9. Case 2. Greenstick fracture of both bones treated by applying cast over the deformity cutting cast around $\frac{3}{4}$ of its circumference leaving "hinge" on remaining $\frac{1}{4}$ and then under fluoroscopic control, wedging the cast aligning the fragments, and reinforcing the cast in the corrected position.



Fig. 3. Case 3. Fracture November 21, 1930. Reduction 3 days after injury

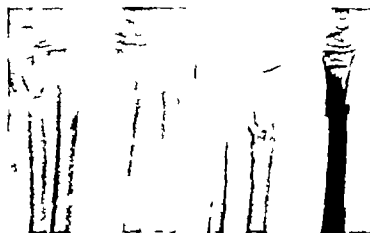


Fig. 4. Case 4. Fracture May 5, 1931. Reduced 3 days after injury

way between pronation and supination. While one of his splints includes the elbow. It cannot as described immobilize that joint and prevent rotatory effort. Clayton prefers mid-pronation although occasionally supination is found more favorable. Maisonneuve recommends external maneuvers, or continuous extension with immobilization, the forearm being in complete supination. In his opinion if reduction cannot be obtained in this manner operation becomes necessary. Jopson advises fixing the forearm on a fulcrum such as a triangular block. Shipley discusses open reduction of fractures of the forearm, immobilizing them with the hand in sharp flexion. Discussing this paper Campbell states that "manual reduction can be obtained in a large percentage of cases by treating both bones as one and angulating. It is impossible to reduce one bone at a time as the other will become displaced again.

Ramey also emphasizes immobilization midway between pronation and supination. Boehler reduces these fractures by traction and fixed countertraction in pronation applying a cast without padding from the axilla to the fingers.

The reduction should be accomplished as soon as possible after the accident. The anesthetic of choice for surgical relaxation in the fluoroscopic room is ether. The fact that several days have elapsed since the accident, and the fact that several previous attempts have been made should not deter the surgeon from attempting this maneuver. In 3 of the writer's cases, 12 and 17 days had elapsed since the occurrence of the fractures, but by the method to be described the fragments were apposed and satisfactory results were obtained. The reduction should be accomplished in a lighted room on the fluoroscopic table the operator wearing colored glasses to facilitate



Fig. 12. Case 5. Fracture May 27, 1931. Reduced same day as injury.



Fig. 13. Case 9. Fracture January 9, 1932. Reduced 2 days after injury.

the view of the fragments when the fluoroscope is used. There are two advantages in working in the lighted room, namely, minimizing the exposure of the operator to the roentgen rays, and secondly, permitting him to see exactly what he is doing, thus avoiding unnecessary trauma to the parts being manipulated.

To describe the technique of the manipulation an overriding fracture of both bones of the left forearm will be chosen as an example. The surgeon stands at the left side of the table. The patient lies on the extreme right side of the table so that it is not necessary to move him when a fluoroscopic view is desired. The elbow of the patient is flexed at right angles and an assistant encircles the arm of the patient with his hands.

During the entire manipulation the forearm of the patient is held in complete pronation. The operator places his left thumb on the dorsum of the distal radial fragment, his fingers grasping the patient's hand over the thenar eminence. With his right hand he grasps the forearm over the distal end of the proximal radial fragment, the thumb of this hand resting upon his own left thumb. Maintaining pressure with both thumbs on the distal fragment the operator gently angulates the fragments, increasing the deformity, and at the same time exerting a distal push and some traction (Fig. 7A).

The surgeon must constantly bear in mind the possibility of injuring the important structures lying anterior to the angulated fragments. The



Fig. 14. Case 10. Fracture February 3, 1932 Reduction 12 days after injury



Fig. 15. Case 2. Fracture April 1932 Reduced 1 day following fracture



Fig 16 Case 15. Fracture April 24, 1932 Reduced same day as injury by wedge-cast method.

protection of these structures by the pronator quadratus is of considerable value. Another safety factor is afforded by working in the lighted fluoroscopic room so that the condition of the soft tissues is constantly evident. The distal push by the thumbs is maintained, the traction in the longitudinal axis is increased and the angulation is gradually decreased as the fragments slid into apposition. The hand, wrist, and distal fragments are straightened and gradually palmar flexed with moderate ulnar deviation, the thumbs maintaining their pressure on the distal fragments (Fig 7B). At this time the room is darkened, and the position of the fragments is checked by the fluoroscope. It is usually found that the pull on the radiocarpal ligaments and the pronator quadratus and the distal portion of the interosseous membrane will have reduced the ulnar fragments during the manipulation of the radial fracture. Should the manipulation fail on the first attempt it should be tried a second and a third time if necessary. When the reduction is complete a circular cast is applied from the axilla to the palm with the elbow at a right angle and the forearm in complete pronation (Fig 8). No stockinette is used. The cast is applied over a moderate amount of sheet wadding, the operator retaining the fragments while an assistant applies the plaster. The writer

recognizes the fact that, handed down through the ages there is a dictum condemning circular casts particularly in the early treatment of fresh fractures. Agreeing that the novice or unskilled must be warned and that even those experienced in plaster-of-paris technique must be ever watchful of circulatory constriction, I have had no misfortune that would cause me to deviate from my routine application of circular casts in fresh fractures. These retain the reduction with greater certainty are not disarranged and cause less circumferential pressure than do bandages and adhesive applied over board or metal splints.

Roentgenograms are taken as soon as the cast is dry. In one case in this series, in which both fractures had been properly reduced, check up roentgenograms showed excellent radial reduction but there was angulation of the ulnar fragments. Through a window on the ulnar side this was completely corrected without anesthesia, and without disturbing the radial fragments. The patient is not dismissed without frequent observation and competent instruction to house physician and nurse or parents if patient is sent home.

Finger motion is started early. The cast is bivalved at the end of 10 days to 3 weeks. The position of the fragments is again verified by roentgenograms. In one of the cases of the writer's series a check up roentgenogram at the



Fig. 7. Case 4. A, Roentgenogram taken after original reduction. B, Roentgenogram taken 13 days later at time first seen by author. C, End result. Manipulative reduction accomplished 17 days after injury.

end of 10 days showed angulation of the fragments. Upon inquiry it was found that the patient had fallen and, without breaking the cast, had angulated the fragments. Satisfactory readjustment was made and a new cast applied. Had no check up roentgenograms been taken, this patient would have had a poor result. When the cast is bivalved heat, passive exercises, and light massage are started.

In younger children, all retentive apparatus is removed at the end of 2 to 3 weeks. In older children, a small portion of the cast representing a posterior mold of the forearm, wrist, and hand is reapplied for protection. In all cases, early supination exercises and mobilization of the wrist and fingers are prescribed.

Greenstick fractures of both bones have been treated by the writer as follows: Anesthesia is usually unnecessary. A felt pad is applied over the angulation. A snug, circular plaster-of-paris cast is applied from the mid-arm to the metacarpophalangeal crease *without disturbing the fractures*. When it has set the dorsum of the cast is cut transversely about one half inch proximal to the site of the fractures and the distal fragments are gently swung into position as the cast is slowly wedged. The fluoroscope or roentgenogram is used to verify the reduction. A few turns of plaster-of-paris are used to fill in the resultant ellipse and maintain the reduction (Fig. 9).

CONCLUSIONS

1. Fracture of both bones of the forearm in children with overriding is a definite clinical entity and of rather frequent occurrence (14.6 per cent of the writer's series).

2. With a few exceptions, a definite technique of reduction is not described in the literature.

3. Exact knowledge of the anatomy and pathology with a mental picture of the structures involved is essential.

4. A definite manipulative reduction in a lighted fluoroscopic room is described. It consists of pronation with anterior angulation of the fragments, and thumb pressure with traction, followed by gradual alignment and palmar flexion.

5. With the forearm in pronation a circular plaster-of-paris cast is applied from the axilla to the metacarpophalangeal crease.

6. Early function of the fingers, wrist, radial-ulnar and elbow joints is advised.

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SPINAL ANÆSTHESIA, NERVOUS SYSTEM SEQUELÆ

A CASE IN POINT

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SPINAL anæsthesia with cocaine and its derivatives is commonly used. Various sequelæ affecting the central nervous system are known, but are individually rare. A discussion of them may be of interest to the surgeon and to the physician considering the use of spinal anæsthesia.

The technique of spinal anæsthesia including the precautions against shock due to the drug used is standardized. Statistics as to accidents deal chiefly with fatalities from shock, and do not give much information about the sequelæ affecting the central nervous system.

Jones maintains that the diffusion of the anæsthetic, which commonly ascends to the cisterna magna and the base of the brain is not determined by the concentration or the specific gravity of the solution used. Johnston and Henderson call attention to certain individual anatomical variations in the spinal canal and the dentate ligament and deposits of fat around the spinal cord as perhaps explaining why the diffusion of the anæsthetic varies. The position of the patient does not account for variations. A more complete knowledge of the absorption of drugs from the cerebrospinal fluid would throw light on this problem.

Davis and his coworkers have shown that spinal anæsthetics have a hæmolytic action on blood cells and a myelolytic effect on tissues of the spinal cord, and that there is a meningeal reaction with plasma and lymph cell exudate not due to infection. Also degenerative changes are found in the grey and white substance. They quote Spelmeyer as finding similar anterior horn changes after anæsthesia of spinal roots. These, however, are not permanent. In animals killed from 30 to 90 days after spinal anæsthesia

fibrotic scarring of the meninges was noticed. Lindemulder describes comparable root, meningeal and cord reactions in a man dying 12 days after operation.

The fall of blood pressure during spinal anæsthesia is not clearly understood. Jones states that the drug acts on the spinal roots and not on the spinal cord. Cranmer and Henrikson hold that fall of blood pressure is due to paralysis of white rami, and a consequent paralysis of splanchnic vessel constrictors. Bower and his coworkers regard blood pressure fall as due primarily to cardiac dilatation which will occur when the drug reaches the fourth thoracic segment level and state that the rate of fall varies with the rate of ascent of the drug in the spinal canal. Ferguson and North state that the rate and degree of blood pressure fall depends on the number of white rami paralyzed. Whatever the mechanism it is reasonable to believe that an unduly great and rapid fall of blood pressure would predispose to cerebral vascular disturbances.

Blatt states that spinal anæsthesia should not be used in individuals with neuropathic constitution. He does not define what he means by neuropathic constitution, but by implication he refers to persons with poor vasomotor tone, who might be over reactive to a widespread diffusion of the drug and the occasional extreme changes in blood pressure and heart action. One can see how the hæmolytic effect of a spinal anæsthetic, observed by Davis et al. might be accentuated in persons with fragile capillaries or unstable vasomotor tone.

Saklad has shown that after spinal anæsthesia alterations in blood chemistry occur much less frequently than after ether anæsthesia. It would seem therefore, that spinal anæsthesia does not

produce a systemic intoxication. Tabanelli found a diminution of red blood cells and a shift in the proportions of the various types of white blood cells. There was no noticeable change in the hemoglobin. Coagulation time showed a slight increase lasting a few hours. Bleeding time decreased in some instances and increased in others. In view of his findings, there is no evidence that the drugs used directly predispose to hemorrhagic reactions of systemic nature.

Angelescu and Tzovaru believe that the delay in appearance of certain sequelae represents an incubation period, and that infection is responsible.

The complications of spinal anesthesia affecting the central nervous system reported in medical literature may be classed as

I *Local or neighborhood* due either to trauma by the injection of the needle, or to the effect of the drug on nerve roots or nearby spinal cord tissue.

II *Distant focal* due to causes not yet determined.

III *General* in which the entire central nervous system is evidently affected with perhaps the major insult limited to certain areas or tissues.

In accordance with this classification, the following clinical conditions have been described.

I *Local or neighborhood* These may be divided into (1) cauda equina lesions, (2) conus lesions, (3) myelitis—in the lower segments of the cord, and (4) spinal claudication (Albo and Pta). The cauda equina lesions are radicular in type. Piccardi reports 3 cases of vesicular eruptions on the heels after the use of tutocaine. I have seen 2 cases of unilateral herpetiform lesions in the upper lumbar segment areas following novocain spinal anesthesia.

II *Distant focal* These may be divided into (1) cranial nerve (2) brain and brain stem, (3) spinal cord.

As to the cranial nerves, primary optic atrophy has been reported by Jacquaeu. Extraocular muscle paralysis are the most frequently mentioned sequelae. They are usually associated at onset with headache, vertigo and photophobia. The external rectus is most often involved. Adams quotes Cushing as explaining these as caused by swelling of the pons and direct pressure on the nerve trunks. Since these paralyses appear several days after the anesthesia, and since there seems to be no clinical or autopsy evidence that pons swelling occurs, this hypothesis is open to question. The exposed course of the abducens nerve makes it especially vulnerable to any insult.

Pallestrini comments on nystagmus as being a common transient phenomenon. De Courcy cited a case of nystagmus appearing about 10 days after anesthesia and lasting for several weeks. Involvement of the facial, auditory and hypoglossal nerves has been mentioned by Angelescu and Tzovaru.

Regarding the brain and brain-stem complications, Arnheim and Mage reported 3 cases of hemiplegia, but one of these can perhaps be discounted because it developed 3 days after operation. Rapoport observed one instance in which sudden death occurred during the operation immediately after the patient elevated his head.

As to spinal cord complications, Bodechtel reported a case of diffuse and ascending hemorrhagic myelitis. The Brown-Séquard syndrome and various other involvements of the spinal cord have been reported. Brachial nerve involvements have been noted (Tabanelli).

III. *General* (1) Headache and stiff neck, lasting a few days, are common, and should not be regarded as either complications or sequelae of spinal anesthesia. Falk finds that these symptoms occur in 6 per cent of spinal anesthesia cases. Other writers give varying percentages, but this figure seems to be approximately correct. Occasional instances have been reported in which headache persists for weeks.

(2) Infective meningitis due to accidental infection during injection also should not be regarded as due to the drug used and in this sense is not a sequela, but rather a complication of infection due to accident. Anderson states that 9 such cases have been reported in 30 years.

(3) Encephalitis has been described by various writers, and the symptoms common are headache, vertigo, photophobia, confusion, hallucinations, and at times extraocular paralysis. Adams mentions one case of stupor lasting 9 days after the anesthetic.

(4) Aseptic meningitis and meningo-encephalitis have been reported.

According to Frick, if death is to be regarded as caused by spinal anesthesia, it must occur within 3 hours after administration. Such fatality happens in about 1 in 10,000 cases, according to Frick and Tendler. Rapoport, in a series of 1,875 cases, reported 1 sudden death following change of head position, and 4 other cases of fatality but believes that the spinal anesthetic was responsible in only two of the series.

Various writers (5 11 16 20 23 25) reporting on a total of 3,074 cases, noticed and described certain central nervous system sequelae in 11 patients (0.5 per cent).

TABLE I

| Date | Blood pressure | Spinal fluid pressure mm. water | Spinal fluid, W.R.C. per cmm. at 100% lymphocytes |
|---------------------|----------------|---------------------------------|---|
| June 11 (morning) | 180/100 | 700 | 170 |
| June 11 (afternoon) | 160/95 | 250 | Not counted |
| June 12 (morning) | 180/100 | 400 | 840 |
| June 12 (afternoon) | Not recorded | 320 | 480 |
| June 13 | 156/80 | 400 | 180 |
| June 14 | 175/90 | 250 | 80 |
| June 17 | 170/85 | 350 | 45 |
| June 19 | Not recorded | 250 | 17 |
| July 5 | Not recorded | 190 | 8 |

Fawcett quoting Reber, stated that extraocular paralysis occurred in 5 of 2,000 cases. Other writers have found it more frequent. Infective meningitis has been reported 9 times in 20 years (3).

Headache, as a transient phenomenon, occurs in about 6 per cent of cases (12, 27).

Published reports of occasional cases of the serious sequelæ do not give any information as to their frequency. I have seen several cases during the past 5 years, and the experience of my colleagues would seem to confirm my opinion that they are not rare.

SUMMARY

1. Certain serious or protracted sequelæ may follow spinal anesthesia. Trauma by the injecting needle, accidental infection during injection (3) and the effect on tissues of the drugs used will account for some cases. There is no evidence that infection is a factor except in the cases of purulent meningitis. The extraocular paralyses have a good prognosis. The toxic or aseptic meningo-encephalitic reactions seem to be benign.

2. There is no conclusive evidence that any one of the various cocaine derivatives used in spinal anesthesia predisposes to central nervous system sequelæ. Blatt, Fawcett, and Levine show that the ocular paralyses are more apt to occur after stovaine than after novocain. This may be due to the slow excretion of stovaine.

3. The hemolytic and myelolytic action of the drugs used as shown by Davis and his co-workers, and the possibility that individual non-anaphylactic idiosyncrasy or hypersusceptibility may predispose to sequelæ justify the drainage of spinal fluid after operation in order to remove any drug that may not yet be fixed in tissues or otherwise eliminated. Anderson has proposed such drainage as a means of reducing headache reaction.

4. There should be pharmacological investigation of how long the drugs used may remain free in the spinal fluid. Cytological and chemical

study of the spinal fluid during a week after operation might throw light on the cause of delayed sequelæ.

CASE REPORT

CASE 1. Mrs. M. F. age 53 years. The patient, an obese woman who had chronic arthritis, was almost totally deaf, and who had had her menopause at the age of 40 developed an incarcerated left inguinal hernia on June 7, 1932. The same day operation under spinal anesthesia was performed. Neocaine, 200 milligrams in 2 cubic centimeters of spinal fluid, was injected in the fourth lumbar interspace, and ephedrine was used before operation. Pre-operative blood pressure was 160/90.

The spinal anesthesia lasted a little over 2 hours. During the operation systolic blood pressure remained steady between 120 and 130; pulse was slow and regular and there was no nausea or vomiting.

The postoperative course was normal until 60 hours after the operation, when the patient was noticed to be dull and incontinent. Her blood pressure was 160/90. The next day June 11 after 20 hours of semi-coma during which glucose solution was given intravenously and by dlysis, there were the following findings: (1) respiration resembling the Cheyne-Stokes type (2) blood pressure 180/100 pulse slow and strong temperature normal (3) dullness in both lower lobes of the lungs (4) neck rigidity and hyperemic optic discs (5) blood urea normal blood sugar 149 milligrams per 100 cubic centimeters (6) spinal fluid showed 170 white blood cells per cubic millimeter and a pressure of over 700 millimeters of water. Blood count was normal. Six hours later blood pressure was 160/95, and spinal fluid pressure was 250 millimeters of water. Culture of this spinal fluid specimen was continued over a week and remained negative. On June 12 the patient was conscious and rational. There was asthmatic respiration with dullness and rales in both bases posteriorly. In the morning spinal fluid pressure was 400 millimeters of water and after drawing 15 cubic centimeters, the pressure was reduced to 150 millimeters of water. Systolic blood pressure was 180. A spinal puncture in the afternoon showed pressure of 320 millimeters of water and 480 white blood cells per cubic millimeter of which 90 per cent were lymphocytes. Later in the day the patient again became stuporous. There was slight weakness of the left face and arm, and a right Babinski sign. There were no signs of meningeal irritation, except a slight neck stiffness. Temperature, urine, and blood urea remained normal. On June 13 the patient was improved. Chest X-ray was negative. By June 17 the mental state was normal, and meningeal irritation signs were absent. Table I shows blood pressure and spinal fluid findings, June 11 to July 5. Between June 19 and July 5 the patient had no complaints, and neurological examination on July 5 was negative. Treatment between June 12 and 19 consisted of forcing fluids, irrigating the colon, and draining spinal fluid to reduce pressure.

From June 7 to June 20 pitressin had been used hypodermically but in decreasing doses after June 14.

This patient developed an aseptic meningo-encephalitis with a complicating asthmatic congestion in the lungs—the symptoms appearing 60 hours after spinal anesthesia and without any ordinary postoperative complication. The marked increase in spinal fluid pressure and the white cell count in which lymphocytes predominated, and

the absence of fever, change in the blood count or other evidence of infection indicate that the spinal fluid contained an irritating substance.

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PILONIDAL SINUS

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IN the 8 years between 1924 and 1931, inclusive, 119 patients 94 males and 25 females, with an average age of 25 years, were admitted to the Massachusetts General Hospital for pilonidal sinus. All of them had active sinuses giving symptoms at the time of admission. Some were original sinuses, and some were recurrent, following one or more previous radical operations.

Twelve of these patients did not have radical operations done, but on the remaining 107 patients 134 radical operations were done by the visiting and resident staff of the hospital. In this study an attempt is made to analyze the results obtained by the prevailing methods of treatment in this series of unselected cases. Comparisons are drawn between the different methods employed and between the original cases and the recurrent cases.

GENERAL STATISTICS

In the 134 operations in the series ether was used 122 times, ethylene 4 times, spinal anesthesia 3 times, local anesthesia 3 times, and nitrous oxide gas oxygen twice. In 70 per cent of the operations methylene blue was injected to make the sinus wall visible. In every case an attempt was made to excise all of the diseased tissue.

The chief difference in treatment was the manner of dealing with the wound. Primary closure either by Lahey's method or some other, was done in 32 cases. In some no drainage whatever was used, and in others a rubber tissue drain was inserted between stitches or at the lower end of the suture line. Those cases in which gauze drainage was used in conjunction with sutures are grouped together under the head of 'partial closure.' This group includes all those cases in which any skin sutures were taken, but in which part or all of the cavity was packed with gauze. There were 37 cases so treated. In 65 cases the wound was packed wide open with gauze, without any skin sutures whatever.

Before the most important question of recurrence is discussed some statistics of lesser importance concerning the series as a whole will be given.

1 The postoperative stay in the hospital averaged 10.9 days.

2 As to the time lost from work because of disability following operation including time in

hospital the average time was 8.7 weeks. Four patients were excluded because their long inactivity was not due to disability but to the loss of their jobs while in the hospital.

3 The time required for the wound to heal according to the patients' report, averaged 2.7 months. Known and suspected cases of recurrence were not counted in the average.

4 Out patient department visits. Of the 134 cases operated upon in the hospital, 22.4 per cent made no postoperative out patient department visits. The rest averaged 9.7 visits apiece.

5 Regarding residual symptoms, of the entire group known to be free of recurrence, only 61 per cent are free of symptoms after the lapse of from 1 to 8 years from operation.

6 The patients were asked whether they thought their result was excellent, good, fair or bad. Fifty seven per cent rated their result excellent or good and 43 per cent fair or bad.

The distribution of these six factors among the differently treated groups is shown in Table I.

It will be noted that the complications responsible for additional postoperative hospitalization of primary closures are shared by the partial closure group. In both groups the stage is set for inadequately drained sepsis.

Once the sepsis is given adequate drainage and the patient is out of the hospital, the partial closure group is on a par with the packed open group in the matter of length of disability. The average disability of the primary suture group is shortened by those cases in which primary union occurred.

It would appear from the next comparison that an equal number of patients having primary closure and those having wounds packed open felt they required no further medical care after they left the hospital. This view was taken by an even larger number of patients with partial closures doubtless due to the fact that their incisions quickly healed to a rather unimpressive sinus which was easy to care for.

Of the patients who did make out patient department visits one would expect more visits by the group with packed open wounds especially in view of their shorter stay in the hospital. The comparatively high average of the primary group is caused by those cases of broken down wounds requiring more prolonged care than any case of open packing or partial closure.

TABLE I—RESULTS

| | Primary closure | Partial closure | Packed open | All combined |
|--|-----------------|-----------------|-------------|--------------|
| Average postoperative stay in hospital | 6 days | 7 days | 8.3 day | 10.0 day |
| Average time lost from work | 8 weeks | 9 weeks | 9 week | 8.7 weeks |
| Percentage of patients who made no out patient department visits | 60 per cent | 30 per cent | 20 per cent | 34 per cent |
| Average number of out patient department visits made by each of the other patients | 9 visits | 9 visits | 1-4 | 9.7 visits |
| Average time to heal | 8 months | 4 months | 9 months | 7 months |
| Percentage of cured patients with residual symptoms | 40 per cent | 30 per cent | 20 per cent | 30 per cent |
| Percentage of patients who rated their result excellent or good | 37 per cent | 43 per cent | 70 per cent | 57 per cent |
| Fair or poor | 4 per cent | 13 per cent | 30 per cent | 1 per cent |

Again the same situation is reflected by comparative healing time. Although the shortest healing times are found in the primary closure group so also are the longest and the average remains almost the same as in the group who had no closure at all.

It would have been desirable to know the symptoms in each case after a uniform time following operation, but since the time elapsed varies from 1 to 8 years, such a tabulation would demand a higher order of intelligence than can be found in the average hospital patient. The present report represents only the symptoms present at the time the investigation was made, that is, anywhere from 1 to 8 years following operation so that it cannot be considered a true end result for the whole series. It can be used in comparing the three treatment groups, however, since the variations in time are equally divided among them.

The fact is inescapable that as many patients with primary closures report residual symptoms as do those with scar tissue wounds. The symptoms in their order of frequency are (1) tender ness or soreness of scar all or part of the time (2) aching of scar after prolonged sitting (3) itching of scar (4) irritation of scar especially in hot weather (5) occasional sharp pains in scar (6) numbness of scar. No type of symptom seems to predominate in any one of the three treatment groups.

The patients rating of their results reflects more than the medical criteria on which we would judge results. For instance, some of the individuals who had the longest hospitalization, convalescence, and disability and even some who were left with symptoms, rate their result as excellent. This is probably because the nature of the condition and its prognosis were carefully explained to them in advance. Others, who were really unusually lucky expressed dissatisfaction, probably because they felt they had been mishandled or

deceived. The dissatisfaction appears to have been greatest in the group of complete and partial closures, and at a minimum in the packed open group.

The possibility of error is, of course inherent in all of these figures based on patients' statements, but it is fair to assume that the inaccuracies are evenly distributed so that for purposes of comparison between groups the figures may be of value.

RECURRENCE

Recurrence is, of course, the ultimate criterion on which success or failure is judged. Table II shows 30 known recurrences in a series of 98 traced radical operations. Whether a higher or lower rate of recurrence prevailed in the untraced fraction might be argued either way. It will be noted on the same table that the lowest rate was obtained by packing open and the highest by partial closure. I believe that the primary closure group might have usurped this latter distinction were it not for the larger proportion of favorable cases it contains.

It is interesting to note that in 15 cases the diagnosis of recurrence was made by out patient department surgeons after failure of the sinus to heal in the following number of months 5 5 3, 12 2 4, 7 2 5 2 11 2 1/2 20 and 24. Seven of these patients are untraced but of the 8 remaining, in all but 1 the wounds are now healed and free of recurrence. The suggestion is that although the recurrences shown in Table II are all based on at least 1 year's observation, it is still possible that some may prove to be cures. Nor can it be denied that some of the apparent cures may still develop late recurrence.

Table III shows the enormous difference in recurrence rate between original cases (that is, cases in which patients have not already had radical operations) and recurrent cases. From these figures it would appear that primary closure in a

TABLE II.—RECURRENCE WITH RESPECT TO METHOD OF TREATMENT

| | Recurrence | | No recurrence | U traced | Total traced operations | Total operations |
|-----------------|------------|----------|---------------|----------|-------------------------|------------------|
| | Cases | Per cent | | | | |
| Primary suture | 10 | 36 | 8 | 4 | 4 | 3 |
| Partial closure | 12 | 50 | | 13 | 4 | 37 |
| Packed open | 8 | 8 | 18 | 0 | 0 | 65 |
| All combined | 30 | 1 | 65 | 30 | 9 | 34 |

TABLE III.—RECURRENCE WITH RESPECT TO TREATMENT AND TYPE OF CASE

| | Recurrence | | | | N recurrence | | U traced | | Total traced cases | |
|----------------|------------|----------|-----------|----------|----------------|-----------------|----------------|-----------------|--------------------|-----------------|
| | Original | | Recurrent | | Original cases | Recurrent cases | Original cases | Recurrent cases | Original cases | Recurrent cases |
| | Cases | Per cent | Cases | Per cent | | | | | | |
| Primary suture | 8 | 31 | | 00 | 8 | | 4 | 0 | 10 | |
| Partial suture | 5 | 31 | 7 | 85 | | | | | | 8 |
| Packed open | | 3 | 7 | 58 | 11 | 1 | 1 | 1 | | 1 |
| Total results | 13 | 0 | 6 | 76 | | | | | 10 | |

recurrent case is doomed to failure, and that open packing offers the best chance of cure. This is, in fact, the policy which has been largely followed in the present series. Note also that partial closure gives a higher recurrence rate than does open packing.

REVIEW OF LITERATURE

Etiology Since Warren's description of pilonidal sinus in 1867 many theories have been advanced as to its etiology. All agree that it is of congenital origin, and most of the theories appear to fall into two main groups. Among the writers who think that it is primarily a malformation of the neural canal are Mallory, Ewing, Prey, Streeter, Tourneaux and Hermann and Delafield and Prudden. The other group including Dulligan, Stone, Bland-Sutton, LeCron and Stolper think that it is primarily an invagination of the ectoderm. H. B. Stone suggests that it may be not a defect at all but an analogue of the preen-gland in birds. Droeck says the sinus is always a blind tract not connecting with other structures. Nevertheless, many cases are described of sinus tracts perforating the sacrum and even communicating with the neural canal (Brams, Martin, Ripley and Thompson, Moise, etc.). Oehlkecker's painstaking observations, already quoted by Cattell and Stoller, lead him to believe that the skin of the "sacral bald spot" is pulled in by its attachment to the caudal filament, which is put under tension by the disparity in rate of growth between the caudal vertebrae and the overlying skin.

Occurrence Many writers feel that the sacrococcygeal dimple sometimes seen in infants is the forerunner of pilonidal sinus. Some of the figures on its incidence are as follows: Lannelongue, 20 to 25 per cent of children; Markoe and Schley, 33 1/3 per cent (89 dimples and 11 fistulae in 300 consecutive births); Lane, 39 per cent (29 dimples and 4 sinuses in 85 children under 4); LeCron, 20 to 30 per cent of all individuals; Lawson, Tait, 23 per cent of women in Birmingham Hospital; Heurtaux, 4 per cent of adults.

Some observers feel that there is a distinctive type of individual in which pilonidal sinus is most prone to occur, characterized by obesity, hairiness, and glandular dysfunction. Morton believes that there is a familial tendency.

Cattell and Stoller report a series of 59 patients composed of 69 per cent males and 31 per cent females. H. B. Stone refers to a series of 61 made up of 84 per cent males and 16 per cent females. The present series of 119 patients contains 80 per cent males and 20 per cent females.

All writers agree that the average age at which symptoms appear is the early twenties.

Prophylactic treatment There are advocates for the removal of all sacrococcygeal dimples as a prophylactic measure. Ottenheimer says, "If the dimpling is patent enough to admit a probe even a short distance operation should be advised." Stone strongly urges the excision of "uninflamed and symptomless sinuses" with primary closure and adds, "it is not meddlesome surgery but sound prophylaxis."

Non-surgical treatment. Maillard reports a case in which cure lasted at least 6 months by treatment with the galvanic current. Crookall describes a method of packing the sinus with dry silver nitrate and advocates it as an office procedure. There is no generally accepted method of treatment, however, except radical excision.

Surgical treatment. A Choice of Times. Many writers feel that the radical operation should never be attempted until abscesses have been drained and sepsis has fully cleared up. Ottenheimer stresses the importance of this, more particularly in cases of primary closure, and Morter puts too early operation at the head of the list of his causes for failure. It is not given equal importance by all writers.

B. Anesthesia. Opinions differ as to the anesthetic of choice. General anesthesia is used by Bookman and Prey, local novocain by Morter, Lane, and Finochietto, and LaRochelle uses a local block anesthesia of $\frac{1}{2}$ per cent butyn solution in conjunction with sodium amytol. Prey makes a point of avoiding local infiltration as he feels it spreads infection through the wound tissues.

C. Skin preparation. Though many writers stress the importance of the sepsis factor few mention their technique for preparing the skin. LaRochelle uses repeated scrubs with a 1:5000 solution of metaphep.

D. Injection of sinus. Most writers feel that the sinus should be injected with dye in order to define the diseased area. Methylene blue is generally used. Babcock advocates the use of a strong ethereal solution of methylene blue. Dulligan advises methylene blue or paraffin. Bookman believes that the technique of injection is important, and describes it in detail. The sinus is first emptied of secretion by pressure over the sacrum. The point of the syringe is then tied into the orifice with a purse string suture placed in the skin. Five per cent methylene blue is injected under gradually increasing pressure aided by massage over the entire region.

E. Excision. LaRochelle uses an elliptical incision at least $\frac{1}{4}$ inch outside of tract, down to the sacral aponeurosis. Dulligan simply says, "elliptical incision down to fascia of sacrum and coccyx." Morter removes the tissue *en bloc* down to the sacrococcygeal fascia. Martin reports a case of sinus penetrating the sacrum and necessitating removal of coccyx and lower part of sacrum. He also urges that the incision be "equilateral to avoid 'hipping' in the healed scar. Ottenheimer removes any fascia that is stained by the dye. Prey has his assistant examine the

specimen for dye while he examines the wound. Finochietto believes that ordinarily it is enough to carry the incision to the plane of the sacrococcygeal fascia, but that this must be carefully scrutinized, and if the tract penetrates it, this tract must be followed into the bone. As for the lateral extent of the excision, some writers seem to be guided largely by the appearance of the dye, while others arbitrarily go out to the origin of the gluteus muscles.

F. Closure. It is assumed that when sacrococcygeal dimples are excised the wound should be closed by primary suture. In the case of fully developed sinuses, however, the question is not so simple. To be successful, primary suture has many inherent difficulties to overcome, and several very ingenious schemes have been devised by its advocates.

Lehey's method is to swing a heavy flap into the cavity from one side, leaving the flap attached at both ends, and packing or suturing the resultant lateral defect. His contention is that a resilient scar is better over a bony weight bearing surface than a rigid, scar tissue one.

Colp uses primary closure without drainage by a method of heavy undercutting and the introduction of strong mattress sutures from the sides reaching across the midline of the fascia. These are tied over a roll of gauze and left in place 8 days if the temperature stays normal. "The majority remain cured."

Prey advocates primary suture provided perfect hemostasis can be obtained by means of ties and hot packs.

Finochietto uses primary suture and states that "primary healing is a proof of complete extirpation and recurrence does not take place in wounds that healed by first intention."

Stone advocates primary suture in clean cases and packing open in doubtful ones.

Ottenheimer places stay sutures under the fascia, closes the fat with multiple layers of catgut stitches, and brings a rubber drain out the upper angle of the wound. He suggests the feasibility of filling the cavity with two butterfly wings of gluteus muscle to furnish a resilient base for the scar.

LaRochelle and Morter describe methods of partial primary closure which they have found successful. LaRochelle closes the skin tight with no attempt to eradicate any dead space. He then cuts two "eyes" near the center of a 12 inch piece of $\frac{3}{16}$ inch rubber tubing which he carries across the subcutaneous cavity through two tight fitting lateral stab wounds. This is left in place for 5 to 7 days, during which time it is used for hourly

irrigations of 15000 metaphen. The wound then "will be healed in another week or two."

Mortier places S W G stay sutures under the fascia, packs the cavity with 3 per cent mercuriochrome gauze, closes the skin with interrupted silk, and ties the stay sutures over the dressing. After 24 hours, the stay sutures, dressing, and packing are removed, and bidaily Dakin's irrigations are carried out for 3 days. After that dry dressings are used. "Eighty five per cent heal without infection."

Eisberg reports a series of 19 cases in which primary union never followed primary suture, while the packed open cases healed quicker than those that were sutured either in part or entirely.

Dulligan also advises packing the wound open. Lane packs the wound open with iodized gauze.

Bookman packs the cavity in layers so that the superficial ones can be extruded or removed and the deep ones left in.

Babcock suggests that time may often be saved by a secondary suture.

G Postoperative care Ottenheimer believes that the location of the wound is unfavorable for healing because, "first, it is so situated that it can be constantly subjected to pressure and irritation either walking sitting, or lying and second its proximity to the rectum makes it readily accessible to contamination from the colon bacillus."

He accordingly suggests the following regimen: (1) castor oil the night before operation and high cleansing enema the morning of operation, (2) liquid diet and deodorized tincture of opium, so the bowels are not allowed to move for at least 6 days after operation (3) patient lies prone or on side for at least 14 days after operation.

H Healing time and recurrence There is a dearth of accurate figures on this subject but general impressions are freely recorded.

In 1912 Griffin and Archibald reported a series of 20 cases from the Mayo Clinic with an average healing time of $8\frac{1}{2}$ weeks—15 remained healed, 4 refused further operation, and 1 was reoperated upon 3 times without a cure. This would make a recurrence rate of 30 per cent. Masson's later report on 81 cases gives no figures about results.

Cattell and Stoller report a series of 59 patients from the Lahey Clinic of which 40 were traced. There were 9 recurrences a rate of 44 per cent. Of the 9 who had the flap closure, 2 recurred. They conclude that the flap method of closure reduces recurrences and healing time.

In Eisberg's series of 19 cases 5 weeks was the shortest healing time and 24 months the longest.

Dulligan gives 3 to 4 weeks as the healing time in cases packed open.

Saphir says it takes 6 to 8 weeks to heal by granulation.

I Residual symptoms There is practically nothing in the literature about this. Lahey feels that a scar tissue covering for a weight bearing surface is a frequent cause of pain and discomfort on sitting.

J Causes of failure Most writers imply that the chief causes of failure are sepsis, incomplete extirpation, and dead space. Prey tabulates the factors which cause failure of primary union after complete suture (1) tension (2) incomplete excision, (3) local anesthesia spreading infection, (4) dead space (5) poor hæmostasis, and (6) operation too soon after acute infection.

Ottenheimer tabulates 8 causes for delayed healing or recurrence (1) Type of patient who has pilonidal sinus, (2) ill-chosen time of operation, (3) unavoidably unfavorable location of wound, (4) imperfect hæmostasis (5) incomplete excision of sinus tract and its branches, (6) faulty obliteration of dead space (7) delayed spontaneous formation of dead space and (8) failure to remove infected sacrococcygeal fascia. He says also "What we consider a recurrence is often not a recurrence of the sinus itself, but an infected dead space of fascia or fat, which eventually breaks through the skin and forms a sinus for itself."

Mortier states clots in the wound assure 100 per cent failure and gives 3 other causes of failure (1) too early operation after acute infection, (2) contamination by cutting into sinus, (3) operation during active infection.

LaRochelle believes that an essential part of his method is keeping the clots washed out by hourly irrigations.

TENTATIVE PLAN FOR TREATMENT OF PILONIDAL SINUS

1 Further observations should be collected as to how often pilonidal sinuses develop in sacrococcygeal dimples. The presence or absence of dimples should be noted on each patient's physical sheet, especially in children, so that readmissions for pilonidal sinus may be checked on this point.

2 No radical operation should be attempted until all acute inflammation has completely subsided.

3 The prognosis and plan of treatment should be explained to each patient before treatment is begun, in order to insure co-operation.

4. A careful 2-day skin preparation should be carried out in conjunction with Ottenheimer's scheme of emptying and clearing out the lower bowel.

5. Infiltration anesthesia should probably not be used if there is any hope of doing a primary suture. It is hard to see how it could fail to spread infection, since some infection is probably always present. It was used in only 3 of our cases, none of them primary closures. One was in the hospital for a month, one made 39 out patient department visits, and the third did well.

6. The sinus tract should be injected by Bookman's technique of securing the syringe point by a pursestring suture. A specially shaped lock syringe adapter should be used. The ethereal solution of methylene blue used by Babcock must be more effective in penetrating the fine branches of the sinus than a water solution. It should be borne in mind that unless the sinus is really injected the use of dye serves only to induce a false sense of security. In over half of the recurrences in our series, the surgeon's note states that since no dye stained tissue was left behind he assumed the entire tract was removed. Although an efficient injection would be of real value, we still have no assurance that every branch sinus communicates with the main stem, so that the absence of dye can never be taken as proof of complete extirpation.

The injection of lipiodol as described by Bruns is available in selected cases. It was of no help in the one case in our series in which it was used. Paraffin has not been used by us, so no conclusions can be drawn.

7. The excision *en bloc* should expose the entire sacral fascia as widely as the origin of the gluteus muscles. Any suspected area of fascia should be excised. Any suspected area of bone should be destroyed by electrocoagulation and curetting. It might be well in certain notorious cases of repeated recurrence to try the effect of concentrated X-ray treatment in the open wound. A case in point is the following:

Number 53: 36 male had a radical excision with partial closure at the Massachusetts General Hospital. Sinus still persisted after 6 months, when second radical excision was done, followed by primary closure. Four years later there was still a persistent sinus, and a third radical excision was done again with primary closure. The sinus persisted for 3 months, when a fourth radical excision was done and the wound partially closed. After 3 years and 4 months, the sinus still persisted, so a fifth radical operation was done and the wound was packed wide open. Healing took place in 6 months, and there was no recurrence 7 years after the last operation. The operator was a member of the visiting staff on each occasion.

8. Primary closure by any of the techniques described should never be attempted in recurrent cases. In original cases it should be attempted only when all of the following conditions can be

met: (1) absence of sepsis (2) perfect hæmostasis, (3) satisfactory extirpation of sinus. Even so it must be remembered that failure (i.e. delayed healing or recurrence or both) may result from any of the following causes: (1) tension on sutures, and (2) faulty obliteration of dead space, or delayed spontaneous development of dead space. Since success brings a great reduction in the time of disability, the hospital time should be enough prolonged to allow a careful postoperative regimen as suggested by Ottenheimer.

If successful, primary closure offers the shortest period of disability and perhaps the most satisfactory scar. If unsuccessful the period of disability is greater than average with a maximum chance of recurrence. It should be undertaken only as a considered risk.

Partial closure of the wound, unless done by the methods of LaRoche or Morter, often is an admission of weak judgment. It is likely that those cases who do well could have had a primary closure, and those who do badly should have been packed open. Partial closure as usually done is open to the objection of leaving bottle-necked dead space which cannot granulate from the bottom to the surface. In our series the disability was long and the symptom and recurrence rate high out of all proportion to any possible benefit to be gained.

If the wound cannot be closed with at least an 80 per cent chance of safety, it should be packed wide open. Whether plain gauze, iodized gauze or mercurochrome gauze should be used, remains to be determined. The out patient department or home management of the granulating wound should be simplified and standardized.

PILONIDAL SINUS REGIMEN

Based on the data given, the following provisional regimen has been put into effect at the Massachusetts General Hospital. A report will be made on the results so obtained when a sufficient series of cases is collected.

1. *Co-operation of patient* The condition and treatment must be explained to patient on admission to ensure co-operation during treatment and return in the event of recurrence.

2. *Choice of operation* Radical operation should be done on clean cases. In abscess cases the abscess should be incised and drained and the patient followed by out patient department or local doctor until acute sepsis subsides.

3. *Pre-operative orders for radical operation* (a) 3 day skin preparation (b) castor oil day before operation (c) cleansing enema morning of operation.

4. *Anæsthesia* General anæsthesia should be used unless it is specifically contra indicated

5. *Scott's solution* should be used in operating room.

6. *Injection* Sinus should be injected with ether solution of methylene blue. The syringe should be secured with a pursestring suture to prevent backflow. Injection should be made under maximum pressure and the sacral region should be massaged during injection.

7. *Excision* A symmetrical block excision is done down to the sacral fascia and laterally to the origin of the gluteus muscles. The blue stain should be followed wherever it goes and widely excised. If it enters the sacrum the tract should be uncovered with rongeurs.

8. *Closure* Closure may be (A) primary (B) partial or (C) wide open. Primary closure is to be attempted only in the presence of the following conditions (a) if the case is original (b) if no gross sepsis or contamination is present (c) if satisfactory extirpation of the sinus tissue has been done, and (d) if hæmostasis is perfect

A. Rules for primary closure are. Any of the plastic methods may be used. All undercutting must be done at full depth of fat layer. All dead space must be obliterated. Delayed formation of dead space must be prevented by mobilizing tissue to a degree that will allow stitches to be tied without undue tension. If a drain is used it should never be left projecting from the lower end of the wound. It should be brought out at the upper end or be between the stitches.

B. Partial closure is not to be used in this series. Any cavity that cannot be obliterated by total closure must be saucerized. Bottle necked cavities lead to 100 per cent delayed healing.

C. Wide open packing with iodoform gauze will be used. (a) in all recurrent cases and (b) in all cases not qualifying for primary plastic closure. One or two sutures at the lower end may be desirable if the anus has been approached too closely. This will not be considered partial closure since it creates no dead space.

9. *Postoperative orders* (A) In the primary closure cases (a) the patient should lie prone or on side at least 8 days. (b) he should be given liquid diet and deodorized tincture of opium to keep the bowels closed for 6 days, (c) patient should be kept in bed as long as there is any suspicion of sepsis (d) frankly septic wounds should be given adequate drainage with or without Dakin's irrigations.

B. In packed open cases (a) patient is to lie prone or on side for 4 days. (b) the bowels are to be kept closed for 4 days. (c) packing should be

changed after 4 days after which packing should be changed daily

10. *Convalescence* The primary closure patient should be kept in bed between 8 and 14 days. The open wound patient should be kept in bed 4 to 10 days. The latter patient should be discharged to out patient department or to local doctor with instructions for daily packing for one week (district nurse wherever possible) and weekly out patient department visits for observation.

11. *Out patient department care* The wound must be kept packed to prevent formation of dead space. Secondary sinuses should be curetted saucerized and kept packed.

Recurrence cannot be diagnosed for at least 6 months and apparent recurrences have healed permanently after 24 months. Delayed healing is the result of the development of a secondary dead space. Only incomplete extirpation of pilonidal tissue leads to true recurrence.

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CORRESPONDENCE

BECK JIANU GASTROSTOMY

To the Editor. In the July issue of *SURGERY GYNECOLOGY AND OBSTETRICS* I presented an improved technique and the indications for a gastrostomy fashioned from a plastic flap of the greater curvature of the stomach. This operation has generally been known as the Jianu gastrostomy after the Roumanian surgeon who did this procedure on dogs and published a report in the *Deutsche Zeitschrift fuer Ch u g* 1912 vol. cxviii, pages 383-391. Dr. William C. Beck has recently called my attention to the fact that his father Dr. Carl Beck of Chicago while working with his associate Dr. Alexis Carrel in 1904, developed a gastrostomy which utilized a tube made from the greater curvature of the stomach. This experimental work on dogs was presented by Dr. Beck and Dr. Carrel before the

Chicago Medical Society and was published in the proceedings of this society in the *Illinois Medical Journal* new series, 1905 vol. vii, page 463. In the later article written by Dr. Jianu, no reference was made to the priority of the American surgeons. I have recently read the original description by Dr. Beck and Dr. Carrel and there remains no doubt in my mind that the credit rightly belongs to these authors. If an eponym is to be used, it should be referred to as the Beck gastrostomy rather than the Jianu gastrostomy. My failure to note this priority can be attributed to the general employment of the term "Jianu gastrostomy" and to the fact that the article on "a prethoracic oesophagus" by Dr. Beck and Dr. Carrel was listed in the *Index Medicus* under "Surgery of the Neck" and not under "Gastrostomy".

GEORGE T. PACK.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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DECEMBER, 1933

OBSTETRICS AND GYNECOLOGY

THE appearance of the third and concluding volume and the separate index of *Obstetrics and Gynecology*, edited by Arthur H. Curtis, and published by W. B. Saunders Company marks an important epoch in the medical literature of the United States.

For many years past important publications devoted to a consideration of this combined specialty have appeared in the foreign literature, notably that of Germany. There are many handbooks available in that language, which are monumental in character. There are practically no comprehensive presentations of this combined specialty published in the English language. There are and have been many excellent textbooks of obstetrics or diseases of women. There are a series of monographs dealing with the varying subject matter pertaining to obstetrics and/or gynecology.

Dr. Curtis has brought together in these three volumes contributions which cover in a correlated manner the present day knowledge in these fields. This is an enormous task in

itself but of even greater significance is the fact that he has been able to secure the earnest co-operation of many leaders who have been willing to contribute their efforts, time, and knowledge to the compilation of these volumes. They present to the students of medicine a systematically edited work on this branch of medical practice.

In such a publication it is not possible to have all the chapters by the various authors of equal merit or originality nor is a uniform style possible. Nevertheless it is of great interest and value to the readers to be able to secure intimate contact with various leaders who have written concerning subject matter which is of particular interest to them.

The main purpose of this work is presented in the opening chapter where it is written that it is the author's idea to present a comprehensive story of "what America has to tell about obstetrics and diseases of women," and to portray the knowledge in the pertinent aspects of anatomy, physiology, preventive medicine, diagnosis, personal management, surgical and non surgical treatment technique, and follow up.

This work may be regarded as a permanent contribution to medical literature as plans are made for periodic revisions as the progress of knowledge requires new presentations. It is refreshing to contemplate that these volumes are committed to the idea that "obstetrics and gynecology are more than mere branches of surgery," that obstetrics and gynecology are highly specialized fields which are most closely related, and that the carrying out of the reproductive function in woman cannot be separated logically from the mor

phology physiology and pathology of the sex and other closely related organs and structures

The content of these volumes makes it perfectly clear that the scope of knowledge required of the obstetrician and gynecologist takes him far from the field of a surgical specialist. It becomes perfectly apparent even to the reader of the table of contents that surgical treatment while of a specialized type in both obstetrics and gynecology assumes the lesser rôle.

Aside from the great importance of this outstanding American treatise devoted to the combined specialty of obstetrics and gynecology one should not miss the significance that it is helping to fix in medical education and practice the growing trend toward the logical combination of these two separate branches in the medical institutions of this country.

The editor deserves great praise in securing the co-operation of so many leaders and in correlating their efforts in the production of the volumes of *Obstetrics and Gynecology* to the advancement of which specialty his life has been devoted.

FRED L. ADAIR

ARTHRODESIS IN JOINT TUBERCULOSIS

AT the July meeting of the International Orthopaedic Society in London the treatment of tuberculosis of the hip was discussed in a symposium and the same subject was brought up for discussion the following week at the meeting of the British Medical Association in Dublin when the rôle of the Fusion Operation in Surgery of the Hip Joint was considered. As a result of these discussions it was very apparent that there should be no sharp distinction between a so called conservative line of treatment on

the one hand and a radical or surgical line of treatment on the other.

In recent years, in the United States, arthrodesis in the treatment of tuberculosis of certain joints particularly of the knee, hip shoulder and ankle, and by indirect attack, of the spine has gained in favor. The chief reasons for this are first uncertainty concerning maintenance of the so called arrest of the disease following apparently successful non-operative treatment and, second the length of time necessary to carrying out of the treatment. There has always been a tendency to avoid definitely recording that the disease has been cured.

Tuberculosis of a joint is a secondary focus, the infecting organism coming by way of the blood stream from a primary lesion situated elsewhere in the body. Many patients with tuberculous joints are found to have other demonstrable lesions in the lungs kidneys, or genital tract although the lesion in the joint may be the most disabling and may be that which forces the patient to seek relief. The treatment of such a joint is therefore a measure directed against a local lesion that perhaps is only one of several foci. All observers are agreed that bony ankylosis in suitable position for function is a happy result in tuberculosis of joints. It is immaterial whether the fusion occurs through natural processes or through surgical intervention.

In the British Isles recumbency has long been recognized as a prime requisite in carrying out conservative treatment of tuberculous joints by rest and fixation whereas in the United States prolonged recumbency has not been looked on as being essential nor in the United States in general are the facilities available, particularly for adult sufferers, for maintaining it. Ambulatory treatment with the best possible fixation by aid of splints or plaster-of-paris casts has been generally used

in this country. It is a fair criticism also, that even with what might be considered ideal facilities and surroundings at command, conservative measures are carried out only too often in a dilatory and haphazard manner. Constant supervision is necessary and the fact that such supervision is so difficult to give is one of the best arguments in favor of production of speedy fusion by surgical intervention. There is ample evidence that fusion of the knee, hip, shoulder or ankle can be produced surgically with satisfactory uniformity.

Those who favor conservative treatment pay little or no attention to the long period of time necessary to attain a successful result nor do they appreciate the frequency with which conservative measures are applied in a haphazard manner. Patients who, after years of treatment in an institution finally have obtained ankylosis by natural processes are pointed to with pride. Although the advocates of conservative treatment readily acknowledge that fusion is quickly accomplished by operation they refer critically to the anuses that may follow arthrodesis and to the occasional case in which the disease is disseminated to the meninges. They fail to remember that the same complications are seen in a certain percentage of cases in which conservative treatment is used. They focus their attention not as they should on whether or not the disease in the joint was eliminated by arthrodesis but on how long the patient lived. Arthrodesis of a tuberculous joint could have no effect on longevity except in so far as it might favorably influence the patient's resistance by removing one of his tuberculous foci.

If the operative mortality were high or if postoperative complications such as dissemination of the disease or prolonged drainage were usual sequences it might be argued

correctly that the operation was too dangerous. Carefully prepared statistics show that the surgical mortality, if the operation is performed by a competent surgeon, is negligible; that the large majority of wounds heal by primary intention and that few post-operative sinuses drain unduly long. There is no reason for such operations being undertaken by surgeons not trained and skilled in the handling of such cases; for comparatively speaking the cases are few and can be cared for at a time and place selected by those competent to carry out such operations. Groups of patients treated by conservative measures and groups treated by operation never have been fairly compared. To make such comparison would be difficult, for the patients should be of comparable age, and should have comparable involvement, not only with relation to the joint affected but also with relation to the number and type of tuberculous foci. The truth is that arthrodesis is only a single procedure in the care of these patients.

Arthrodesis is undertaken to obliterate a local condition in any given joint, and the obliteration should be thorough. It is an incident in the treatment of a systemic disease and its usefulness depends on whether or not it eradicates the disease in the particular joint attacked. The late Sir Robert Jones stated that tuberculosis of a joint should be, when possible, treated as a local malignant growth. There is too great a tendency to split the treatment of tuberculosis of the joints into the so-called conservative and radical (operative) measures. As a matter of fact operative treatment may be the more conservative type because in selected cases it hastens healing and allows the patient to return to productive life in a much shorter time than would be possible under the regimen of recumbency, rest, fixation of the joint.

heliotherapy and so forth. Arthrodesis is not applicable in all cases multiple foci are accompanied by poor general condition of the patient, draining sinuses with or without amyloid disease and involvement of both kidneys are contra indications. Old people

and young children are generally thought not to be good subjects for arthrodesis. Probably the operation is not used often enough in treatment of children especially if the disease is characterized by much destruction of the surfaces of the joint M. S. HENDERSON

EARLY AMERICAN MEDICAL SCHOOLS

SCHOOL OF MEDICINE, TULANE UNIVERSITY OF LOUISIANA

ALTON OCHSNER, B.A. M.D. F.A.C.S. NEW ORLEANS, LOUISIANA

Department of Surgery, School of Medicine, Tulane University of Louisiana

THE conception and the founding of a medical school in New Orleans, which is now the Medical Department of Tulane University of Louisiana, was largely the result of the efforts of two young physicians, Thomas Hunt and Warren Stone, whose original acquaintance was largely one of accident. It is also rather unusual that these two men whose previous training had been entirely different should be responsible for the development of one of the greatest medical institutions in the United States. Thomas Hunt was born in 1808 of wealthy parents. After graduating from the University of Pennsylvania he secured additional training in Paris before returning to Charleston. Warren Stone, also born in 1808 was the son of a Vermont farmer and had none of the advantages as regards education which Hunt had. He graduated from the Medical School of Pittsfield, Massachusetts, and began practice in Troy New York. While there, early in his practice, he was called upon to treat the first case of cholera in the city which occurred in a French immigrant. He became very much interested in the condition, which undoubtedly had much to do with his subsequent career. Shortly after this he left New York en route to New Orleans on the ship *Amelia* together with one hundred and seven other passengers. There were four cases of cholera on board when the ship left New York which number after 4 days increased to twenty five. During a severe storm the vessel was grounded on Folley Island near Charleston and it was here that Hunt and Stone met, the former being placed in charge of the camp on the island. Following the incident on Folley Island Stone continued to New Orleans, arriving there in December, 1833 and was soon appointed on the Charity Hospital Staff Hunt, because of his acquaintance with Stone soon afterward moved to New Orleans and was appointed house surgeon to the new Charity Hospital in New Orleans, which position he held until he resigned in 1834 to devote his entire time to the founding of a medical school of which he, Stone and Harrison, Hunt's successor at Charity Hos-

pital, had dreamed. Through Hunt's influence Stone was appointed assistant house surgeon under Dr. John H. Harrison. He, however performed the teaching duties of Harrison who, because of ill health was unable to carry on an active teaching schedule even for the first year.

These three men were responsible for the conception and founding of the first medical school in the South and Southwest. On September 29, 1834, the following partial prospectus of the Medical College of Louisiana appeared in the *New Orleans Bee*:

The undersigned practitioners of New Orleans, convinced of the want of scientific medical knowledge in the state and in several of the adjoining states, and of the non-existence of schools necessary for the diffusion of that knowledge and aware too that acquaintance with the peculiar diseases which prevail in this part of the union cannot be made in Cincinnati and Philadelphia, but must be obtained by students at the bedside of the patient, and anxious to advance the cause of science and to disseminate the knowledge of human suffering and to put an end to the murderous practice and empirical arts of selfish speculators on the ignorance of vulgar credulity and thereby to increase the happiness and prosperity of the country have associated themselves together as a Faculty for the purpose of delivering Medical Lectures in the city under the name and style of the Medical College of Louisiana.

In selecting New Orleans as the place for the location of their school the undersigned have been governed by the following among other reasons:

- 1st. Because it is the largest and most populous town in the Southwest and most accessible to students.
- 2nd. Because its hospitals which will be open to the undersigned for the purpose of instruction are the largest in the Southern and Western states, so that Practical Medicine and Surgery can be taught at the bedside of the patient, the only place for this study.
- 3rd. Because the study of anatomy can be prosecuted with more advantages and at a cheaper rate here than in other cities of the United States.
- 4th. Because New Orleans is so healthy during eight months in the year that student can remain in it and study different types of diseases at different seasons.¹

¹For the benefit of our northern colleagues who are not familiar with New Orleans today it should be emphasized that the eight months should be extended to the entire year.



Fig. 1. Teisone University School of Medicine, 1834.

- 5th Because it is a commercial town and more surgical accidents occur to seamen than any other class of individuals and it is consequently the best field for the study of Surgery in the Southwest.
- 6th Because in consequence of its great population, its hospitals are filled with patients.
- 7th Because, as the undersigned pledge themselves, students can get board at twenty five dollars a month

A Home Institution has already been too long wanted among us. The expense attending the acquisition of knowledge in schools at a distance from us has heretofore closed the door of science against the poor student and has caused this part of the country to be overrun with Quack Doctors, to the destruction of human life. An institution like that we are about to establish, which will bring knowledge to our doors, impart instruction at the cheapest possible rate and afford the opportunities of medical education to all who may feel inclined to avail themselves of them must lead to the advancement of Science and the rational treatment of disease by regular bred Physicians, and cannot fail, in whatever point of view it is considered, to obtain the good wishes of every philanthropist and friend of science. Besides, to the student of Medicine in the Southwest it will recommend itself by this unanswerable reason for a preference over any similar instruction at a distance it will enable him to study diseases and their treatment in the efforts in which he intends to practice, and will supply him with that information which is necessary to his successful practice, and which he could not obtain except at home.

The undersigned respectfully invite the attention of students of medicine of the Southwest to the above observations and, confident of success, announce that The Lectures of the Medical College of Louisiana will commence on the first Monday of January 355 and will continue for four months from that date.

Thomas Hunt, M.D. Professor of Anatomy and Physiology

John Harrison, M.D. Adjunct.

Charles A. Luxenberg, M.D. Professor of Principles and Practice of Surgery

J. Monroe Mackie, M.D. Secretary Professor of Theory and Practice of Medicine.

Thomas R. Lagalla, M.D. Professor of Chemistry and Pharmacy

Edwin B. Smith, M.D. Professor of Materia Medica.

Augustus H. Cress, M.D. Professor of Obstetrics and Diseases of Women and Children.

Demonstrations in practical anatomy will be given daily by the Adjunct Professor of Anatomy and Physiology. Chemical lectures will be delivered twice a week at the Charity Hospital. The Hospital will be open every day for the attendance of students.

(Signed) THOMAS HUNT, M.D.

Dean of the Faculty

New Orleans, September 25, 1834.

There was considerable opposition to the founding of the new school as evidenced by letters published in the lay press at that time. The fact that the faculty was composed almost entirely of English speaking physicians (In a community in which the majority of physicians were French trained) that they were self-appointed, and that many were young was objected to by many of the local profession. One is referred to Foster's excellent and complete review of this controversy.

The period of instruction was not long. In the original prospectus the following appeared. To be entitled to a degree the candidate must have



Fig. 2 Josephine Hutchinson Memorial erected in 1893

pursued the study of medicine for at least three years with his preceptor he must have attended at least two full courses of lectures¹ he must have passed an examination by the Faculty of the College, he must be at least twenty-one years of age he must present no faults of character he must submit a satisfactory thesis upon some phase of medical science." The tuition was high approximately one hundred and fifty dollars a session. The fees were as follows: Matriculation fee five dollars; fee for tickets for each professor twenty dollars; demonstrator's tickets, ten dollars; graduation fee thirty dollars.

The school was awarded its charter by the state legislature on April 2, 1835. At the first session which terminated April 27, 1835 there were eleven students. In the session 1835-36 there were sixteen students. On April 5, 1836, twelve men were awarded diplomas, which were the first degrees awarded in medicine or in science in the Southwest. In 1840 a small building was secured in the vicinity of the Charity Hospital. Prior to this the teaching had been done largely in the homes of the professors and the Charity Hospital. In 1845 through the efforts of Thomas Hunt at the time of the adoption of the new constitution for the State of Louisiana provision was made for the establishment of a State University of which the Medical College of Louisiana was to become the Medical Department of the University. A building was erected by the State and in return for the financial

aid received from the State, the faculty of the medical school agreed to attend the patients at Charity Hospital without remuneration for a period of ten years. In 1847 a larger Medical School building was erected by the State at an approximate cost of forty thousand dollars and was one of the largest and best equipped medical buildings in the United States. This building was a part of a group of University buildings located on Baronne and Common streets which were occupied until 1898 (Fig. 1). In 1844 a surgical amphitheater was erected on the grounds of Charity Hospital, half of the funds for which was contributed by the Faculty of the Medical School. In 1850 an appropriation of twenty five thousand dollars was made by the State Legislature for the purchase of anatomical, obstetrical, physiological, surgical, pathological and dermatological preparations, models and drawings. Wax models of skin diseases were obtained from Mr. Town's original collection at the Guy's Hospital, London. Anatomical preparations were secured from the Academy of Anatomy in Florence. The museum of these models and preparations was one of the finest and largest in America and probably equalled any in Europe. The size of the student body increased in number until in 1846 there were one hundred enrolled. In 1858 there were two hundred and seventy six and in 1860-61 there were over four hundred students. The activities of the medical school were suspended during the years 1862 to 1865 because of the Civil War. The College was again opened in 1865 and since then

¹The second year consisted largely of a repetition of the first year's lectures.

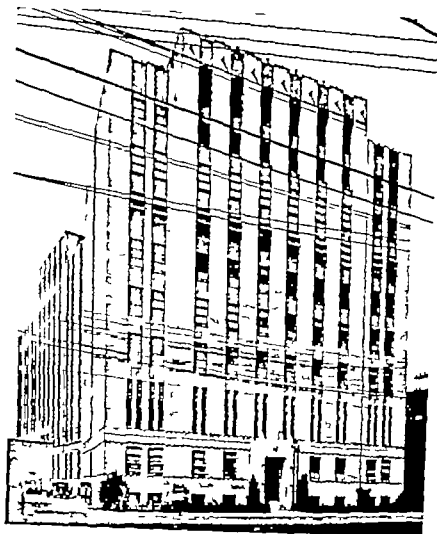


Fig. 3. New Hutchinson Memorial Building completed December 1, 1930.

has uninterruptedly prospered, the total number of graduates up to the present time being 6,350.

In 1882 Paul Tulane, a resident of New Jersey of Huguenot descent, who had amassed a fortune in New Orleans in the clothing business, donated over a million dollars to found a university in order that the young white persons in the city of New Orleans might be educated. Tulane, while a boy visited relatives in Nashville. On one occasion he went to Louisville to witness the arrival of the first steam boat from New Orleans. Upon arrival of the boat he was impressed by the large number of Louisiana planters who were bringing their sons to Kentucky schools, which was customary at that time. In the devastating reconstruction period following the Civil War such an

education became impossible and it was in order that a similar education might be obtained in New Orleans that Paul Tulane gave the money some thing over a million dollars—a considerable sum at that time, for the founding of the University which today bears his name. In 1884 the University of Louisiana became known as Tulane University of Louisiana, and the Medical College of Louisiana became the Medical Department of the Tulane University of Louisiana. Since this time the College of Medicine of Tulane University has maintained the policy originally intended by Paul Tulane i. e. a Louisiana and southern school primarily for southern boys. The new Tulane University was built on St. Charles Avenue opposite Audubon Park. However the medical school

continued in its old domicile on Baronne and Common Streets until 1893 when Mrs. Richardson, the wife of Dr. T. G. Richardson, who for years had been a valuable and loyal professor and dean of the Medical College, donated funds sufficient to erect a new medical building on Canal Street (Fig. 2). In 1906 the first two years of medicine were transferred to the campus on St. Charles Avenue at which time another Richardson Memorial Building was constructed. The building on Canal Street because of donations by Alexander Hutchinson after his wife's death to increase the efficiency of Tulane Medical School and provide furthermore for a free clinic for the destitute sick of all races, colors and creeds became known as the Hutchinson Memorial Building. This building continued to be used as the administrative offices, the research laboratories and class rooms for the two clinical years until December 1, 1930 when a new Hutchinson Memorial Building (Fig. 3) was completed on Tulane Avenue adjoining Charity Hospital. This building was made possible by a donation of one and a quarter million dollars from the General Educational Board. The building is modern in every respect, houses the administrative departments, research laboratories, class rooms, and an outpatient department for the two clinical years. It is unique in the respect that the building is so arranged that the outpatient teaching is conducted in individual offices. Each senior student has for his own individual use what corresponds to a well equipped private office. In the building there are one hundred and five such offices equipped with

the necessary examining tables, desks, chairs, dressing cubicles, sterilizers and laboratory facilities for routine laboratory work. The examination and the care of patients in the outpatient department is done entirely by senior students under the supervision of instructors. The hospital teaching is still conducted in the great Charity Hospital which because of its wealth of material including almost every type of lesion and morbid process, is an admirable teaching laboratory, and in the Touro Infirmary where there is also abundant clinical material.

One of the chief contributions which Tulane University has given to medicine has been the researches in vascular surgery. Warren Stone in November 1849 was the first to cure an aneurysm of the vertebral artery. Syme first ligated successfully a subclavian artery, whereas the contributions of the master surgeon, Rudolph Matas, to this field of surgery especially as regards the conservative treatment of aneurysm by endoaneurysmorrhaphy, and the transvenous suture of arteriovenous aneurysm are too well known to need further elaboration.

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REVIEWS OF NEW BOOKS

THE third volume of Curtis *Obstetrics and Gynecology*¹ is just off the press. The first two volumes have been reviewed by W W Chipman and Irving Cutter. The book before us is opened with a section on "Displacements and Relaxations" to which Baer, Farrar and Ward have contributed. It is prefaced by a short introductory chapter by Curtis who warns against the tendency to over correct injuries sustained in childbirth and stresses the value of reconstruction without undue tension, fixation, or rigidity.

In the section on "Disturbances of Function" C. Jeff Miller presents a well written chapter on dysmenorrhea which for practical reasons, he is inclined to consider as a disease though actually it is merely a symptom. The various types of uterine hemorrhage, amenorrhea and scanty menstruation, and, finally the disturbances of the menopause are discussed by Novak. The subject of sterility has been entrusted to Rubin to whom we are indebted for a most interesting chapter. Reis contributes an instructive discussion of various sex problems such as vaginismus, dyspareunia, sterilization.

The following section on "The Endocrines in Gynecology and Obstetrics" is probably the best that has yet been written in the English language. Allen of the Allen Dohay test fame, Corner, Philipp E. Smith and Engle have divided the field to which they themselves have made such notable original contributions, and discuss the ovarian hormone, the corpus luteum, and the anterior pituitary hormone, respectively and the whole problem is gathered up, as it were, in a chapter on gynecological endocrinology by Novak. That this writer has been able to present the vast material concisely and yet exhaustively in only 27 pages, is but another proof of his masterly grasp of the subject.

The next section comprises a number of unrelated topics. Keene and Kimbrough write on endometriosis which they consider unreservedly in the light of Sampson's explanation of transubsternal endometrial transplantation, though they admit that in a few instances inflammatory, congenital, or metaplastic factors may be at work. Now that this controversial subject has already produced an immense and at times confusing literature, this chapter should prove particularly helpful, and as to treatment, it seems

especially appropriate to underscore the contention of the authors that "It is wise to err on the side of conservation the disease being essentially one in comparatively young women. A chapter by Anspech on ectopic pregnancy in which he emphasizes the diagnostic value of the various tests of pregnancy is followed by a scholarly discussion of leucorrhea by C. H. Davis. We may have debased ourselves in the belief that genital fistulae that bare in the days of Marlon Sims, have no longer their former practical importance but "with the increase in the number of complicated pelvo-abdominal and obstetrical operations the rare fistulae are becoming more common" and for this reason Rank's chapter on the subject will be a valuable reference. Hyperplasia and (true) endometritis are competently presented by Novak. In the dissertation by Lynch on backache it is important to note that pelvic disorders were responsible for this symptom in fully 49 per cent of his cases, as proved by careful follow-up investigation. Frequent assertions to the contrary notwithstanding the chronic congestion that usually occurs in a retroflected uterus with prolapsed ovaries, may cause backache even in the absence of inflammatory complications, and the pain can be cured by surgical means. The reviewer is quite in accord with this attitude though he would prefer a trial with pessaries prior to any operation.

The succeeding section on "Other Gynecological Diseases and Symptom Complexes" is headed by a chapter on lesions of the cervix wherein Holden gives a very clear presentation of this subject and goes into satisfying details regarding treatment. Richard R. Smith adds a short chapter on erosion of the meatus urinarius and urethral caruncles. Then follow four chapters on diseases of vulva and vagina from the authoritative pen of Tausig, a discussion on gynastresia by Gordon, on inversion of the uterus by Irving, and one on the clinical aspects of congenital malformation by Masson and Rieske.

The last section of the work contains numerous "special topics." Curtis contributes a chapter on gynecological history and examination, and one on the early months of pregnancy from a gynecological standpoint. Counsellor writes on the relations of appendix and large bowel to gynecology a subject which is naturally of great practical value to us. "Urinary Tract Problems in Gynecology" are treated separately by Hunner and by Danforth. Case offers a large chapter on obstetrical and gynecological roentgenography and Burnam follows

¹Obstetrics and Gynecology. Edited by Arthur Hale Curtis. 3d Vol. 2d ed. Philadelphia and London: W. B. Saunders Company 1933.

him with an exhaustive treatise on radium. The subject of blood transfusion is dealt with by Fitzgerald and Koch, that of pre-operative problems by Gardner. Anesthesia is Towell's topic, and hypnosis and analgesics are discussed by Maxwell. Curtis furnishes a chapter on operative management and postoperative care which reflects his rich experience. Though for lack of space the various subjects in the book could be mentioned only in the briefest outline, the reviewer cannot refrain from quoting the author's dictum that the old adage 'Haste makes waste' should in gynecological surgery be paraphrased as 'Haste makes morbidity and mortality.' Of particular interest are the discussion by Pollock on neuropsychiatry in relation to gynecology and obstetrics and the closing chapter of the book in which Middleton writes on the connections between internal medicine and obstetrics and gynecology. In these two chapters bridges are built between our specialty and mother medicine.

The mere recounting of the contents of this volume can not do full justice to the excellence with which each of the multitudinous topics has been handled. The editor has, indeed, known how to choose his collaborators. As Chipman pointed out in these columns a few months ago, many of these chapters are real monographs. This necessarily involves a certain amount of overlapping but so splendid has been the co-operation of editor and associates that repetitions have been reduced to a minimum. I do not pretend to have studied all of the 1200 pages of this volume. That would have been physically impossible in the time set for me for this review. But in going through chapter after chapter I have found practically nothing that could seriously be questioned, and very little that seems to have been omitted. There are 1664 illustrations in this one volume. Because of the prohibitive cost of reproduction in color they are almost altogether in black and white. The paper, however, is of such good quality that even the photomicrographs come out perfectly clear.

Each volume has its own index and in addition there is a separate General Index of 137 pages to all three volumes which will be found extremely convenient.

Now that the complete work is before us, it is possible to evaluate more fully the significance of this undertaking. It is for the first time that the profession in English speaking countries has had access to a reference work of this size and scope. We are not dealing with a textbook sufficient for the needs of undergraduate instruction but with a real encyclopedia, a summary of knowledge which will be of importance alike to the advanced student, to the practitioner in search of guidance, and to the experienced specialist. As such it is a credit to American gynecology and obstetrics of which we may justly be proud. But beyond any national limit, it is a monument to our specialty itself. It proves, if further proof were needed, that obstetrics and

gynecology are indivisible, and the bibliographic references at the end of each chapter show that the sources of our knowledge come from all the world and have nothing to do with political or geographical frontiers. The eighty contributors have done their best to present the present status of this knowledge. But in our fast moving time new truths are found constantly, and former views are apt to be revised. To prevent this work from ever becoming obsolete, we are promised that every five or eight years a new edition will embody all the progress made in the meantime so that this *Obstetrics and Gynecology* will steadily advance with advancing generations.

Editor and publisher deserve our thanks for their great achievement.

GEORGE GILLBERT.

THE 350 page monograph¹ by Jarcho is the first attempt in English to describe the part which the pelvis plays in modern obstetrics. The author places particular emphasis on pelvimetry and especially on roentgenological mensuration.

This emphasis has led the author away from sound clinical judgment. The statement on page 9 that practitioners unskilled in mensuration have come to depend upon the dangerous test of labor² must not go unchallenged. A test of labor properly used, will always remain the final test of any given pelvis. Every obstetrician with experience has seen pelves, with measurements indicative of dystocia, permit rapid and uncomplicated delivery. The size of the fetal head the fetal attitude of flexion or varying degrees of deflexion, the position of the fetal head at the pelvic inlet, etc. all play rôles in the ultimate outcome of any given labor. Pelvic mensuration alone cannot give a definite prognosis except in the few instances of absolute disproportion. The borderline pelvis must have a test of labor for proper obstetrical evaluation. The author himself agrees with this thought on page 111 where he states that a test of labor may be allowed before cesarean section is decided upon. Furthermore a properly conducted test of labor is never dangerous. This is obvious to every experienced obstetrician. Jarcho must feel that it is safe or he could not recommend it as he does in the text of the book.

The author has gathered together a considerable bibliography and quotes freely from the literature. He has, unfortunately, been careless in several instances in failing to give credit to other workers in this special field. The method of lateral pelvimetry on page 269 has been described previously by Thoms in the *New England Journal of Medicine* for 1929, volume 200 page 899. The author's method of roentgen ray cephalometry on page 277 is practically that originally described by Thoms in 1930 (*J. Am. M. Ass.*, xcv, 21). Jarcho's method of roentgen ray pelvimetry, originally reported in the *American Journal of Surgery* for November 1931 differs from that of Thoms (*J. Am. M. Ass.*, 1929,

¹ THE PELVIS IN OBSTETRICS: A PRACTICAL MANUAL OF PELVIMETRY AND CEPHALOMETRY INCLUDING CHAPTERS ON ROENTGENOLOGICAL MEASUREMENT. By John Jarcho, M.D. F.A.C.S. New York. Paul B. Hoeber 1932.

xvii, 1915) only in that Jarcho places the patient in the sitting position rather than in the semi-recumbent position. Later in the work, the author reverses himself and states that he places the patient in the semi-recumbent position.

The book is profusely and well illustrated but the same carelessness noted above, has caused the author to fail to give due credit to Sturmdorf for illustration 55 on page 171. Sturmdorf first described the measurement of the lumbosacral index in *SURGERY GYNECOLOGY AND OBSTETRICS* in August 1931 xliii, 209.

The reviewer cannot agree with the statement that "the fundamental cause of difficult labor is that the child's head and the mother's pelvis do not fit nor to his concluding statement that roentgenological pelvimetry now offers a practical and exceedingly exact means of determining the pelvic diameters.

It is to be hoped that a second edition will include the necessary changes as there is a definite place in obstetrics for a work such as this.

RALPH A. REED.

IN *Swanberg's Radiologic Maxims*¹ the material is presented in short terse statements, usually 2 to 6 lines in length, each dealing with a particular phase of radiological diagnosis. Of the 122 pages, 64 are devoted to roentgen diagnosis and the remaining 58 to radiation therapy. The first few pages deal with general radiology. The second section on roentgen diagnosis covers bone pathology; the chest, the gastro-intestinal tract including the gall bladder, the genito-urinary tract, obstetrics and gynecology and the skull. Roentgen therapy, radium, and ultraviolet rays are adequately taken care of.

Included in each section dealing with a particular branch of diagnosis or therapy are short quotations or statements by prominent, well qualified physicians who are not radiologists, but who are highly trained in that particular field.

The maxims presented deal not only with what can be expected of a roentgen examination or radiation therapy but in many instances present the indication for such an examination or therapy.

E. E. BARTER.

*THE Cyclopaedia of Medicine*² is to consist of 12 volumes of material, arranged alphabetically, which will embrace virtually the entire system of practical medicine and surgery with a complete survey of the specialties and medical sciences. Dr. George M. Pernal is editor-in-chief and he has selected a group of associate editors chiefly from the Pennsylvania medical schools to assist him. Much of the material is supplied by other associates, also.

¹HANDBOOK MAXIMS. By Harold Swanberg, B.Sc. M.D. F.A.C.P. With a Foreword by Henry Schwartz, A.M. M.D. F.A.C.P. F.A.C.S. Quency Illinois. Radiological Review Publishing Company 1934.

²THE CYCLOPAEDIA OF MEDICINE. By George M. Pernal, B.S. M.D., editor-in-chief, and Edward L. Kutz, A.B. M.D., associate editor. Charles E. de M. Bayne, M.D. LL.D., Edw. Jenner, and Ben. editor vols. I, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12. Philadelphia: F. A. Davis Co. 1933.

selected because of their pre-eminence in the various fields of medicine and medical sciences, not only from most of the great medical schools of the United States and Canada but also from many of the countries of Europe, Central and South America. The volumes are of a convenient size (7 by 10) of 700 to 1000 pages, in attractive flexible green bindings. The material is well printed on substantial paper. The disease entities have been discussed in an orderly way from the standpoint of etiology, pathology, symptomatology, differential diagnosis, and treatment. The operative technique together with pre-operative and postoperative management has been emphasized in the care of the surgical disorders, gynecology, obstetrics, ophthalmology and otolaryngology. An example of the care with which the editor has prepared this set is indicated by securing such splendid sections as infections of the hand, backache, bacteriology, immunology and others.

The first volume starts with the topic "Abdomen, acute," and a good differential diagnosis ends up with a well balanced consideration of the problem. The individual discussion of appendicitis comes at the end of the volume. Drugs both old and new, such as aloes, allonal, and avertin, are discussed from the aspect of the pharmacologist. Anesthetics, amputation, and animal extracts are examples of subjects appearing in this alphabetical arrangement which are well treated. To date only the first 7 volumes have been published but the reviewer feels that if these volumes are an index, the cyclopaedia will prove to be very useful to the large number of physicians not only in general practice but to those interested in special fields. Dr. Pernal states that it is planned to bring out a supplement from time to time to cover the rapid advances and constant changes taking place in medicine. M. HERBERT BARBER.

IN a volume of seven hundred pages with five hundred illustrations, Bland presents a textbook³ of obstetrics which had its origin in a set of obstetrical notes and tables that had been prepared and used for teaching purposes by the author. The illustrations contained in this text are well done and are graphic. The subject matter is well presented and one finds it easy reading. There is a definite departure from the arrangement found in most standard textbooks, in that Bland treats of all of the pathology of pregnancy—antepartum, hemorrhage, ectopic gestation, toxemias, etc., and the treatment of these conditions—before normal labor is considered. It would seem that for the beginner to have a true appreciation of the rationale of various methods of the treatment of placenta previa, for example, he should have some knowledge of the mechanics of normal labor.

In the chapter on Symptoms and Diagnosis of Pregnancy a rather complete list of metabolic,

³PRACTICAL OBSTETRICS FOR STUDENTS AND PRACTITIONERS. By F. Bland's Bland. Assisted by Theodore L. Montgomery, M.D. Philadelphia: F. A. Davis Company 1934.

chemical, and biologic tests is described. The importance of the Aschheim Zondek test in the early diagnosis of pregnancy is properly stressed. In the same chapter under the discussion of X-ray in the early diagnosis of pregnancy, Bland states that X-ray as a diagnostic aid is not available until after the sixth month. This statement is repeated in a subsequent chapter. This is very surprising and contrary to the general consensus of opinion in regard to the time at which fetal skeletal outline can be demonstrated by roentgenography.

In the chapter on 'Antepartum Hemorrhage' the author presents a very graphic description of placenta previa by illustrations. However a departure from conservative, operative obstetrics is noted when manual dilatation of the cervix is mentioned in connection with the treatment of placenta previa.

Tables of differential diagnosis are to be found throughout the book which deal with the more common complications of pregnancy and labor and should be rather helpful to students. The Hillis impression method of estimating disproportion between the fetal head and the maternal pelvis is described and this maneuver in experienced hands is a very valuable procedure in the last weeks of pregnancy when a disproportion is suspected. A rather comprehensive appendix of referred reading is included in the book.

The reviewer feels that this textbook will be valuable for the students of Bland as it will illustrate and augment his particular lectures and should be a worthwhile book for the obstetrician's library.

CHRISTIE C. DOWNEY

THE authors present in the 1932 volume of *The Year Book of Radiology* a résumé of the most important articles on radiology that have appeared in medical literature the past year. The abstracts presented are concise but nevertheless give the essence of the article. In the compilation of the various articles the authors present 493 illustrations, which are well reproduced and which add greatly to the value of the book. The majority of the illustrations are reproduced from the original roentgen films or photographs. The articles used are not only those appearing in radiological journals of America but are drawn from the many periodicals in the field of medicine which deal with radiology. The authors have also drawn from the great university clinics of Europe. This enhances the volume greatly especially to the physician who is not conversant with foreign languages.

The volume covers the field of roentgen diagnosis, roentgen therapy and radium therapy. Important advances have been made in the newer phases of roentgen diagnosis, such as encephalography, venitriculography, intravenous urography, pelvimetry, hepatosplenography and studies of the heart and aorta. In the field of gastro-intestinal diagnosis tre-

mendous advances have been made by the revised methods and the various agents employed. The use of opaque material in small quantities followed by the injection of air has opened a field of great possibilities. The literature dealing with hepatosplenography by means of thorium dioxide is compiled and the procedure is gradually gaining favor.

In roentgen therapy the *r* unit is being used almost exclusively. This standardization of a unit of dosage has been an important step in roentgen therapy. The newer equipment providing for much higher voltage which will deliver a quantity of X-rays equal in quality to the γ rays of a four gram pack, is enthusiastically praised by some advocates. Numerous communications dealing with radium bomb or massive radium pack type of therapy are presented. This type of treatment is available only in the endowed institutions at present and the results are being awaited with considerable interest. It is highly praised by workers in Stockholm, Paris and parts of the United States but the English have found the four gram pack of little value. The method of Couillard in treating malignancy of the upper respiratory tract is being quite generally used both in America and in Europe and is being accepted as the method of choice in the treatment of these lesions.

The volume should prove very valuable to the busy physician who has not the time to cull through the vast amount of material presented, and it should serve as a working reference acquainting him with the more recent advances in radiologic science. Although the reviews are often brief the articles used having already been presented in condensed form the project and the satisfactory manner of presentation are to be highly commended and the volume unreservedly recommended.

EARL E. BARTH

IN the preparation of his book, Dr V. Meisen has covered the whole field of varicose veins in detail. At the same time he has not been verbose in the work. He has drawn from his extensive experimental work at the Royal Veterinary Hospital both for the pathology of varicose veins and in a study of the pathological reactions present following the injection treatment of same. He discusses very clearly the association of varicose veins to varicose ulcers as well as to the other complications and end results often found present. His technique of the treatment is simple and clearly stated though not as carefully worked out as has been done by some of the American physicians and authors. The book is well illustrated and is very well published. It is without question the best book on this subject published abroad.

H. O. McPHERTERS.

THE authors of the book on postural defects are well qualified Yale University men. One is pro-

¹ALFRED K. VEECH and HANDEBROOK; AND THEIR TREATMENT. By V. MEISEN, M.D. With a Preface by ALF. KROGH, Ph.D. Copenhagen. Levin & Munksgaard, 1931; London. Oxford University Press, 1932.

²THE DIAGNOSIS AND TREATMENT OF POSTURAL DEFECTS. By Winthrop Morgan Phelps and Robert J. H. Kipphut. Springfield, Illinois and Baltimore, Maryland. Charles C. Thomas, 1932.

THE 1932 YEAR BOOK OF RADIOLOGY. DIAGNOSIS. Edited by Charles A. Waters, M.D. THERAPEUTICS. Edited by Ira L. Kaplan, B.Sc., M.D. Chicago. The Year Book Publishers, Inc., 1932.

fessor of orthopedic surgery the other is assistant professor of physical education. They treat the subject in an interesting manner. The book is the outgrowth of a study of the male students of four institutions. One chapter deals entirely with the statistical report of the material drawn from examinations of the students of all age periods. The first two chapters deal in a fascinating manner with evolutionary and environmental influences on posture.

The evolutionary trend of posture from the primordial organism through fish, amphibian, reptile, primitive mammals, tarsoid primates, ancient anthropoids, prehuman and finally human stages is presented. In the development of earth-living animals the suspension posture occurring in tree-living adaptations and the supportive posture in ground-living adaptations is presented as being directly influenced by gravitational force. The environmental influence and its effect on the final adult posture is traced from intra-uterine and babyhood influences through the pre-school and pre-adolescent periods into the adolescent and young adult stages.

Normal posture is defined as the average of a large number of postural examinations under the same conditions. There is the ideal normal group, normal and individual or habitual normal postures. No attempt was made to judge type normal because the authors feel that the judgment of posture should depend, not on the question of slenderness or obesity, but upon the mechanical efficiency of the position.

Body mechanics from the standpoint of the individual joint is anatomically presented in a scientific manner. The mechanical influence of one joint upon another and the effect on the posture of the whole body when individual joint mechanics vary from the normal is carefully analyzed.

Posture examination comprises a large chapter and deals with the variations or deviations from the normal of the individual joints with structural or functional changes. The importance of recording the degree of variation in order to note subsequent favorable or unfavorable changes with therapy is stressed.

Posture in physical education has undergone radical changes from the traditional routines of the past. The tendency of individual study and exercises has resulted in a new method of physical education.

A complete chapter on corrective exercises is excellently presented with a detailed explanation of how to perform each exercise.

The book is well illustrated with photographs, diagrams, and anatomical sketches.

No one treating posture or teaching physical education should be without this book. Its appeal is greatest to orthopedists, physical therapists, and teachers of physical education. **PURVIS LARKIN.**

AS its name implies, Brooke's *Shorter Orthopedic Surgery*¹ is a very condensed text covering the field of orthopedic surgery. The text is divided into

anatomical subjects, chapters consisting of those on hip joint, knee joints, foot and ankle joints, shoulder joints, hand and wrist, the neck, spine, and pelvis. In addition to these, there are chapters on arthroplasty and amputation, and one on plaster-of-paris technique. The important phases of most of the subjects counted as orthopedic surgery are touched upon in a very brief manner. The book is quite well illustrated with photographs, roentgenograms, and drawings. There is no general consideration of disease entities, other than as they involve the specific joints.

In the main, the treatment outlined is conservative, one exception being that of the fibular transplant to replace the resected head of the humerus in tuberculous of the shoulder joint.

As a handbook of orthopedic surgery, this book is acceptable but it can in no way displace the more extensive standard texts now available.

FREDMONT A. CHANDLER.

THE results of various surgical procedures on the pelvic sympathetic nervous system in such gynecological conditions as pelvic neuralgia due to carcinoma of the cervix, so called essential pelvic neuralgia and dysmenorrhea, dyspareunia, and vaginismus, cystalgia and functional disorders of the urinary bladder, leucorrhoea and intractable hydromenorrhea, disturbances of the sexual sense, pruritus vulvae, amenorrhoea, aplasia, and trophic changes of the genital organs, are presented by Gaston Cotte in his *Chirurgie du Sympathique Pelvien en Gynécologie*.² The conclusions are drawn both from his own experience and from that reported in the literature of the subject.

Of the various surgical procedures which have been used in the disturbances mentioned, resection of the superior hypogastric plexus seems to be, according to the author's experience, the procedure of choice. The technique of the procedure, advocated by Cotte in 1924 for the first time is described in detail.

The author finds reason for attacking the sympathetic nervous system to relieve these various pathological conditions in the assumption that by section of the sympathetic nerves the organs innervated by them are cut off from the more highly situated sympathetic centers, and that the visceral plexuses are thus liberated. Thus the pathways for pathological reflexes which may originate in a diseased organ, and which in turn might produce such disturbances as dysmenorrhoea, hydromenorrhea, pruritus vulvae, kraurosis vulvae, etc., are divided. According to the author, peri-arterial sympathectomy produces not only a hyperemia of the denervated organs, but a modification of the status of abnormal reflexes.

There is occasionally also a histological basis for surgical intervention upon the sympathetic nerves. For instance, in 31 cases of essential dysmenorrhoea, not associated with apparent lesions of the genital

¹ BROOKES' ORTHOPAEDIC SURGERY. By R. Brooke, M.S. F.R.C.S. New York: William Wood and Company, 1925.

² CHIRURGIE DU SYMPATHIQUE PELVIEN EN GYNÉCOLOGIE. By Gaston Cotte. Paris: Masson et Co., 1925.

organs or pelvic peritoneum microscopic examination of the superior hypogastric plexus revealed in 16 cases definite signs of a neuritis. In 3 cases the nerves were found sclerotic and in 1 case the plexus presented a neuroma. In 2 cases neuritis of the plexus was concomitant with a cellulitis in the neighborhood. In 9 cases the plexus was found to be histologically normal.

Care must be used that the sympathetic nervous system be approached at the proper site, in essential pelvic neuralgia with the pain located chiefly in the region of the uterus, spreading thence toward the anus, coccyx, and perineum, the nerve to be divided is the superior hypogastric plexus. In pain mainly in the lumbar region the procedure of choice is resection of the nerves entering the hilus of the ovary or if the procedure is technically difficult a respective ramification section of the superior hemorrhoidal nerves, in addition to resection of the superior hypogastric plexus, is indicated in cases in which the neuralgic pain is chiefly of anorectal location.

The author further emphasizes the point that the operation upon the pelvic sympathetic nerves in gynecological conditions be done only to relieve complaints or symptoms which can be directly attributed to the function or dysfunction of and not for conditions obviously not concerned with, the sympathetic nervous system.

A combined operation on the pelvic sympathetic nerves and the genital organs or the adnexa, however conservative the procedure may be makes it very difficult to establish the exact part played by each procedure in the relief of a given pathological condition. Therefore the conclusions drawn from the author's observations are not always entirely convincing for instance, while in 91 cases of essential dysmenorrhea which was either the only symptom present or was associated with leucorrhoea dyspareunia, frigidity constipation enterocolitis dysuria etc., the treatment is listed as successful without any additional operation upon the adnexa we find actually only 3 cases in which the treatment was resection of the superior hypogastric plexus alone. In the 88 other cases this procedure was combined with appendectomy, ligamentopexy or even occasionally by enucleation of a follicular cyst or partial resection of an ovary.

The lack of exact anatomical and physiological data concerning the sympathetic innervation of the various pelvic organs is another reason for our inability to accept without reservations the conclusions arrived at as to the value of operations upon the sympathetic nerves in conditions of a gynecological nature.

The participation of the sympathetic nervous system in these various disturbances might occasionally suggest that operation would be of value in relieving the distress. However a thorough study of the problem, both from the anatomical and experimental point of view is needed before exact indications for operation can be determined and results evaluated.

G. CHOMOSKI

THE five hundred page monograph on fractures of the extremities by René Simon professor of the Faculty of Medicine of Strasbourg is divided into three parts. The author first considers fractures in general from the standpoint of biology etiology and anatomy. He also describes the general symptoms and methods of treatment. A chapter is devoted to problems of the union of fractures and the treatment of compound fractures in general. The second part of the book covers the consideration of fractures of the upper extremity and the third part, fractures of the lower extremity including those of the pelvic girdle.

The material is presented in concise form without lengthy bibliography or controversial opinions. In general, the author presents his concepts of the modern knowledge of fractures. He has no unusual or radical theories or methods to present. His consideration of fractures of the upper and lower extremity are well classified, according to the bone involved and the particular parts of the bone. He presents the various methods with their advantages and disadvantages, as well as their application to particular types of pathology.

The book contains neither photographs nor X rays however it is remarkably well illustrated by diagrammatic sketches portraying the author's concepts of the bone pathology.

In summary it may be said that while this book adds nothing particularly new in principle to our knowledge it gives an adequate conception of the French viewpoint of fractures of the extremities and advocates open reduction more frequently with a more general use of plates and screws.

ARTHUR H. CONLEY

THE third volume of *The Practice of Medicine* of the series edited by George Blumer appears about a year after the first two volumes. The author's preface clearly states the purpose and essential points emphasized in this volume. It is the purpose of this volume to present the material ordinarily covered in the standard textbook on internal medicine diseases of the nervous system excepted. The underlying idea has been to give a lucid account of the present knowledge of each disease which is at the same time authoritative concise sufficiently comprehensive for all practical purposes, and free from confusing discussions of unsettled though possibly interesting problems. There has been an attempt where possible to emphasize the relation of trauma to internal disease a field which has been brought into the limelight by workmen's compensation laws. The reader will perhaps find that the emphasis on various diseases is not exactly that to which he is accustomed. With the passage of time some diseases become less important, while others arise or assume more importance. Typhoid fever for ex-

LES FRACTURES DES MEMBRES; CHOMOSKI ET THÉRAPEUTIQUE. By René Simon. Paris: G. Douin & Co., 1933.

THE PRACTITIONER'S LIBRARY OF MEDICINE AND SURGERY. Vol. III. Fractures of Medicine. New York and London: D. Appleton and Company, 1933.

ample, is less extensively treated than in many of the other treatises, but typhoid fever is a disappearing disease. Tularæmia and undulant fever have a good deal of space assigned to them, they are diseases which are becoming more prevalent and therefore more important to the general practitioner. In the same way the section on allergic diseases is much fuller than is usual in a work of this kind but, here again, we are dealing with a new field which is constantly growing and assuming greater and greater importance. In this volume, as in the preceding ones, an attempt has been made to make the material easily available. Dr. Blumer has selected various groups of men to assist in creating this series. Many of the contributors to volume III are relatively young men but they are men especially interested in the specific subject assigned to them and they are active investigators in their respective fields. Some of the assignments appear rather broad for an occasional contributor so that some parts of some subjects are rather weakly treated. Joseph Moore outlines the section on syphilis with pertinent comments from his experience upon points of question to all treating syphilis. He outlines treatment so that good management is immediately visualized by those less familiar with the various problems arising. The author discusses undulant fever, staphylococcal infections, rickettsial infections, food poisoning, diseases of the peritoneum omentum mesentery mediastinum, and diseases of the diaphragm. He includes poisoning from bites of reptiles and insects. A definite attempt is made to include many subjects met in ordinary practice which are not found in the standard texts. On the whole the material is nicely arranged, well written, and a good bibliography follows each subject.

M. HERBERT BARRETT.

THE book by Pusey entitled *The History of Dermatology*¹ contains nine chapters with thirty two illustrations and an historical index. It is the only history of dermatology in English and represents, in the main, the story of the masters in that field and in medicine in general, in so far as it is related to dermatology from 3000 B.C. to the beginning of the twentieth century.

In tracing the gradual development and progress of dermatology through the centuries, in the different countries, the author identifies these with definite landmarks of advancement in science and culture and in that sense, the monograph may be said to reflect the history of civilization.

The flowing, literary and narrative style of the author conveys to the reader a vivid, human portrayal of the pioneers in dermatology. The book is not merely a recital of facts and events of interest to every disciple of Æsculapius, but provides an evening of entertainment and will be enjoyed by every physician.

The historical index of dermatology in the back of

the book, preceding the general index, is a valuable asset to every dermatologist in that it furnishes a bibliography of skin diseases with accessible references for the study of the subject.

On the whole, it is a book very much worthwhile.

EDWARD A. OLIVER

THE book, *Infections of the Hand* by Allen B. Kanavel is radically changed and improved in its new sixth edition. The subject is discussed under four parts in an effort to simplify the presentation and make it conform more nearly to the usual textbook style.

Part I of the book is concerned with the anatomy of the hand and forearm. Many excellent cross sections of the hand and forearm demonstrate and clarify the anatomical relationships of these structures. The relation between the synovial sheaths and major fascial spaces is stressed and demonstrated by drawings and X-rays from the experimental studies obtained by the author following injection of these structures. The illustrations from these injections show the avenues through which infections of the hand may spread. The general principles peculiar to infections of the hand are given. Part I therefore covers the anatomical and experimental considerations as a group unlike the previous editions in which they were intermingled with the clinical problems.

Part II considers the localized infections and clinical entities exclusive of lymphangitis, major fascial space and tendon sheath infections. Considerable new material gathered from the recent work of the author and his associates has been inserted into this part. The additions include the peculiar course of infections from bites and injuries from teeth, the pathology and treatment of metacarpophalangeal joint infections, of gangrenous infections, of injuries from indelible pencils, of cattle hair and other peculiar infections.

Part III gives the diagnostic factors and treatment of the three severe common types of infection of the hand, lymphangitis, tenosynovitis, and major fascial space infection. The signs, symptoms, diagnosis and treatment of these infections are very appropriately classified and discussed under eleven chapters. The author emphasizes the fact that two lesions, lymphangitis and suppurative tenosynovitis, are often unrecognized and improperly treated. He warns against hasty incisions for lymphangitis and urges early recognition and treatment of suppurative tenosynovitis. Frequent reference is made to the anatomical and experimental studies of Part I in discussing the spread and treatment of these infections. Illustrations are included showing the location of the various incisions made for infections of the tendon sheaths and forearm extensions.

Part IV consists of five chapters covering complications, sequelæ and after treatment of infec-

¹INFECTIONS OF THE HAND. GOING TO THE SURGICAL TREATMENT OF ACUTE AND CHRONIC SYNOVIAL PROCESSES IN THE FINGER, HAND, OR FOREARM. 6th ed. By Allen B. Kanavel, M.D. Sc.D. Philadelphia: Lea and Febiger, 1933.

THE HISTORY OF DERMATOLOGY. By William Allen Pusey, A.M., M.D., LL.D. Springfield, Illinois and Baltimore, Maryland: Charles C. Thomas, 1933.

nons of the hand. The present edition includes a more detailed description of the many new splints used by the author and his associates. The author emphasizes the importance of maintaining the "position of function" throughout the treatment of infections of the hand. In the position of function "the hand is in dorsal flexion at the wrist at an angle of 45 degrees, the phalanges at the metacarpophalangeal and phalangeal joints should be flexed to the same angle and most important, the thumb should be abducted from the palm adducted toward the ulnar side of the hand and rotated so that the flexor surface of the thumb is opposite the flexor surface of the index finger.

This new edition of *Infections of the Hand* remains the masterpiece and authority on the subject. It is a distinct improvement over the earlier editions in that its organization and presentation make this rather difficult subject easier to read understand and assimilate. The book is indispensable to the student, general practitioner and, above all to the surgeon. It cannot be too highly recommended.

ELLIOTT C. CUTLER

THE first edition of Aschheim a well known monograph on the diagnosis of pregnancy from the urine was out of print shortly after its appearance.¹ The second edition is enlarged and rearranged so as to include further investigations of the author himself as well as the results of other investigators who are working along the same lines.

The final work along this line has not of course been done. Much remains to be clarified before the subject is a completed one. Nevertheless this mono-

graph is distinctly worth while because it carries the work up to the present moment. RALPH A. REIS.

THE book by Maingot *The Management of Abdominal Operations*¹ describes the procedures which he uses in his practice. It is obviously intended as he himself says in the preface for internes and for the general practitioner who only occasionally comes in contact with the management of abdominal operations. The descriptions are concise and clear but very brief in order to enable the author to embody the entire subject in the small handbook.

The idea is excellent. The need for just such a treatise is very definite. The present textbooks on pre-operative and postoperative management are altogether too voluminous to be used for ready reference by the busy interne. The book naturally is dogmatic there is not space for a review of other people's opinions. Because of this dogmatic phase, the book will probably find disfavor with many surgeons whose practice differs from that of Dr. Maingot furthermore there will be a limitation in its value for use by the interne for just this reason. Naturally in a small handbook, such as this present volume, it is impossible to cover the entire subject and the author has picked such conditions as he evidently thinks are the most important. Excellent as the book is, it is very probable that the difference in the author's technique from that which may be practiced in other established institutions, will interfere to a certain extent with its general acceptance. However, the reviewer does feel that it will be of great service to the physician who finds himself in charge of abdominal cases of a surgical nature.

RALPH BOERNE BETTMAN

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